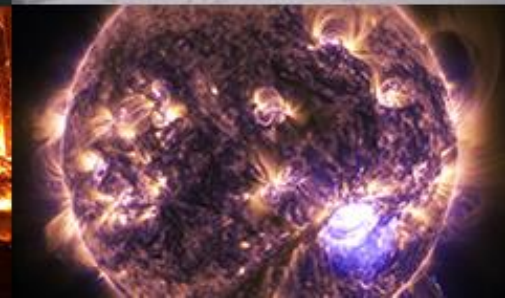
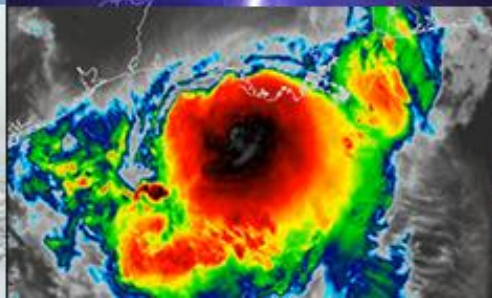




NATIONAL
WEATHER
SERVICE

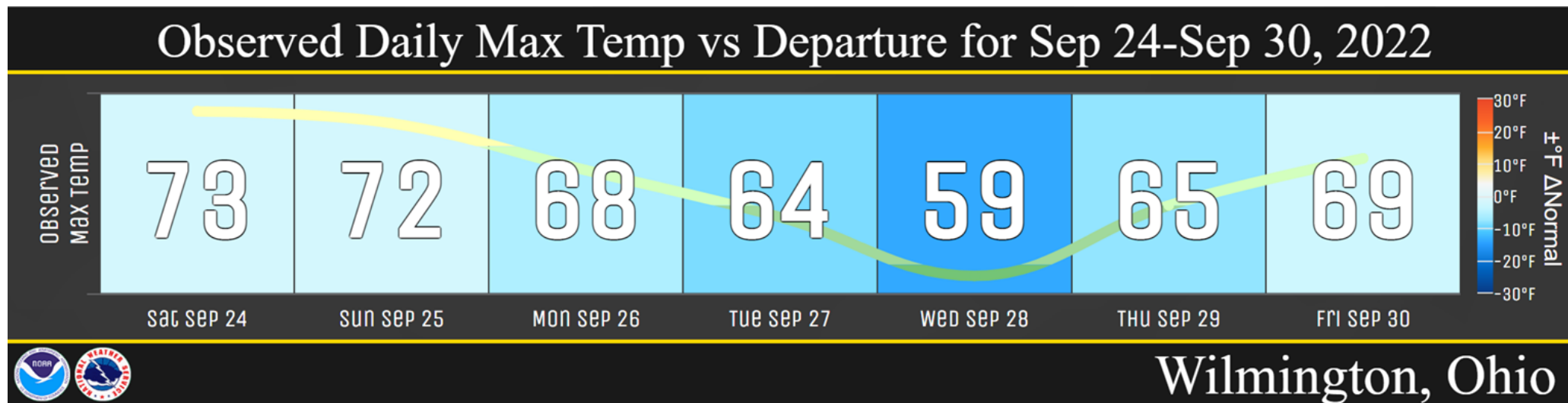
Weather and Climate Ohio EMA Spring Conference

Nate McGinnis
Weather Forecast Office - Wilmington OH



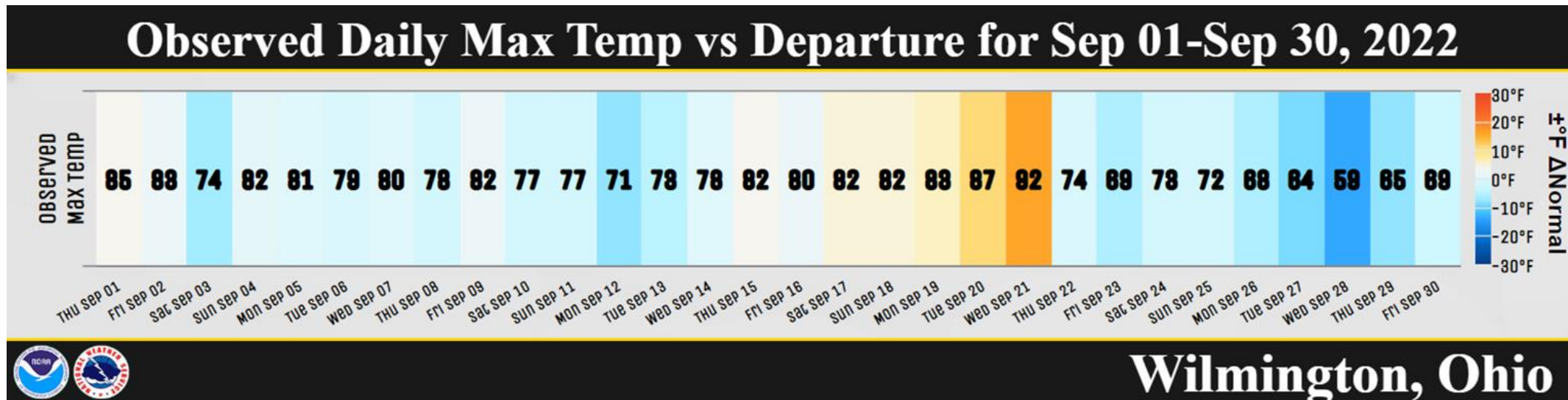


Daily Stripes For a Week



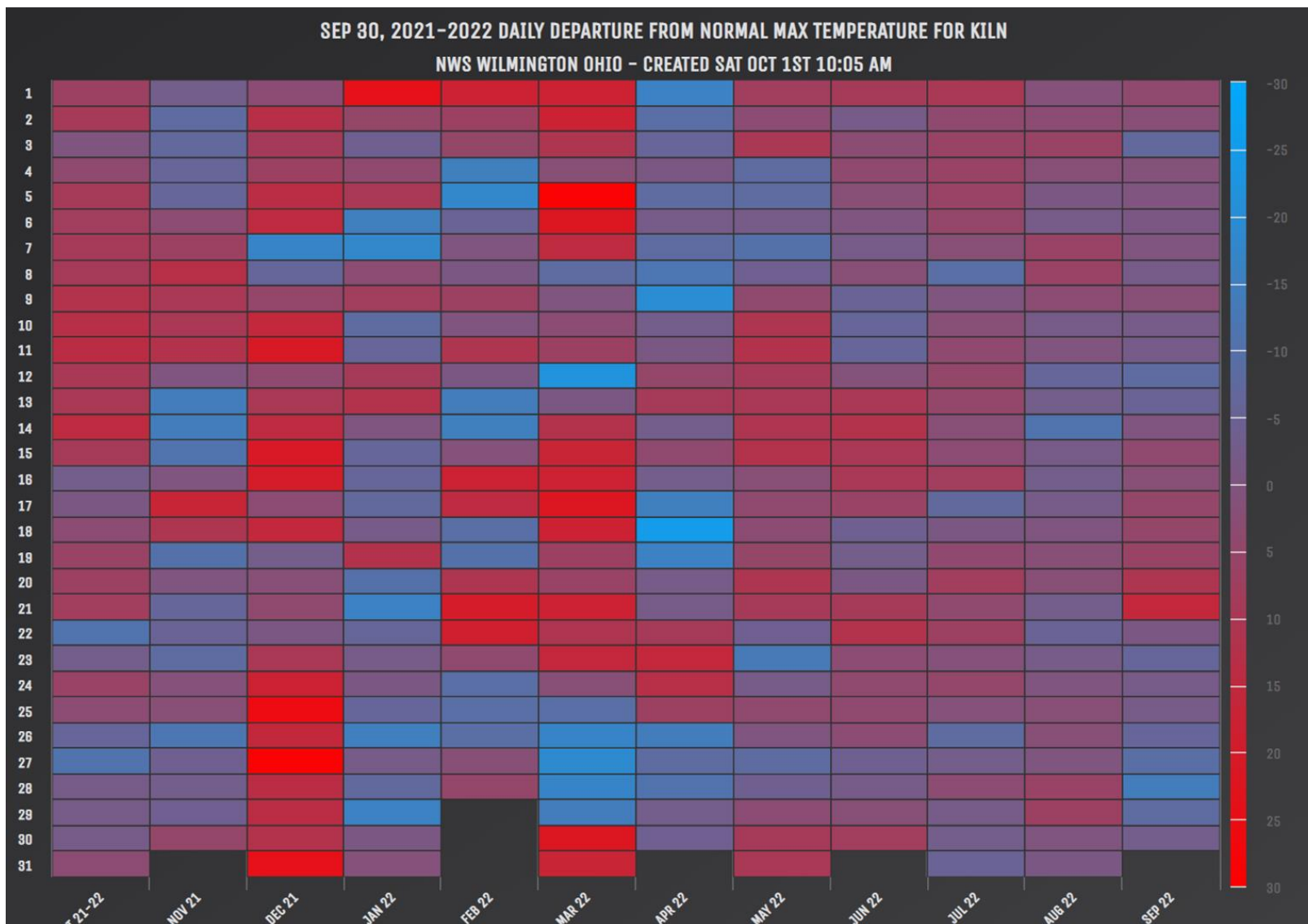


Daily Stripes For a Month





Daily Stripes For a Year

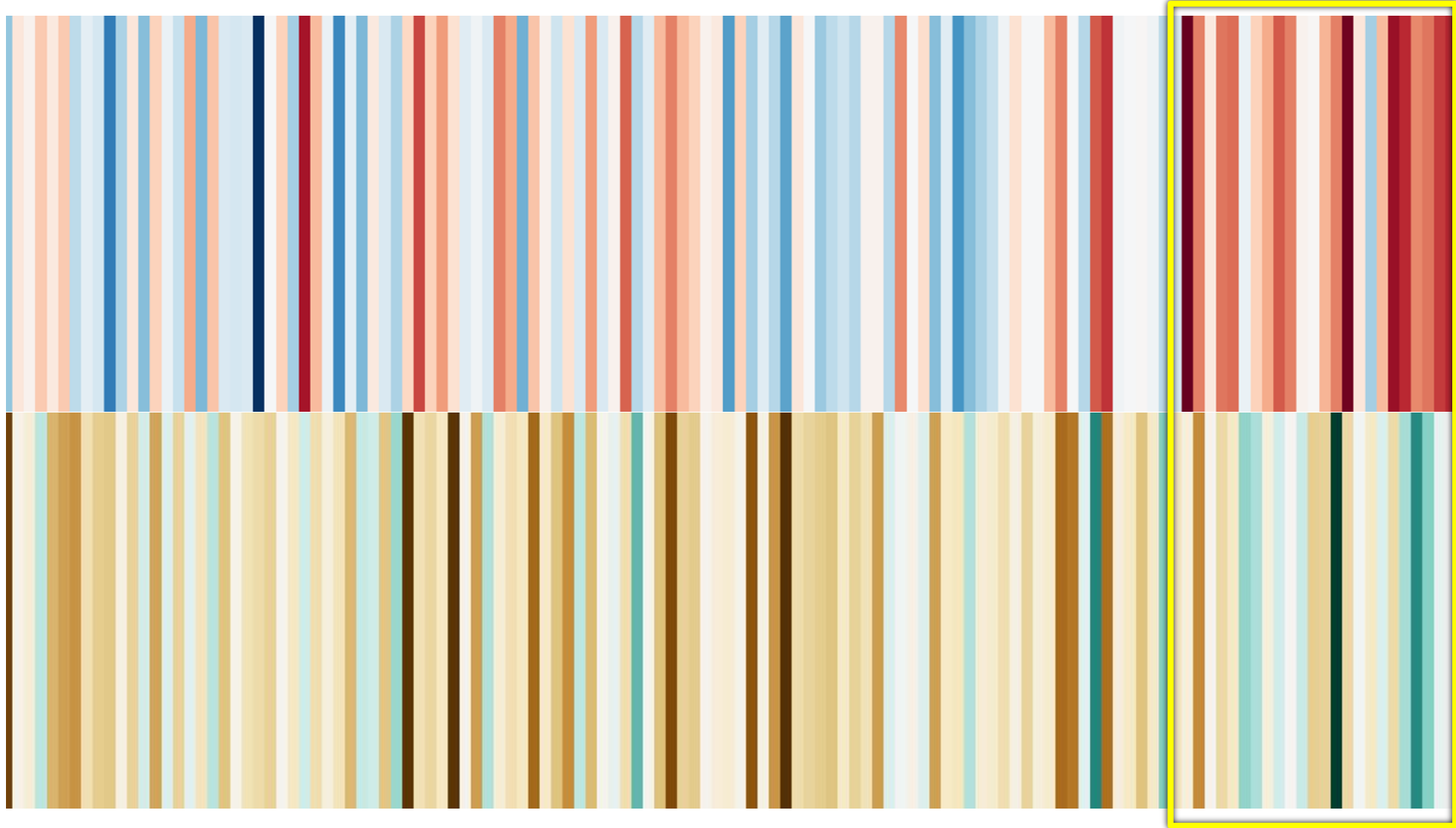




Yearly Stripes



1895

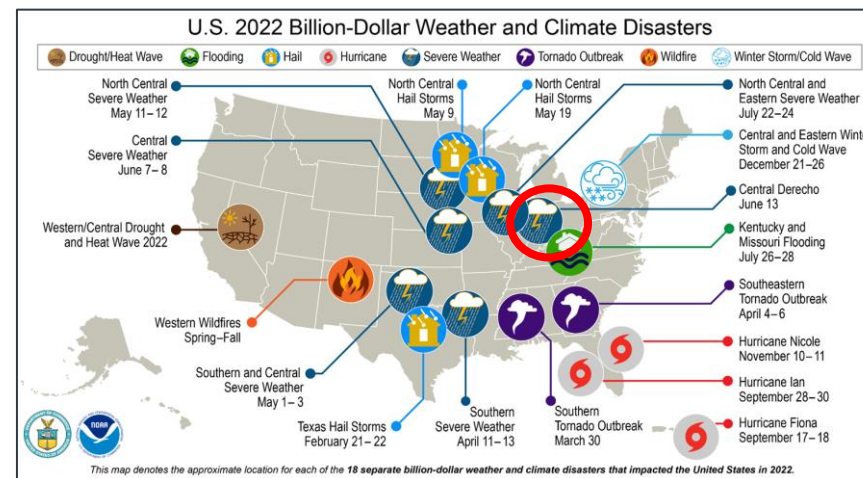
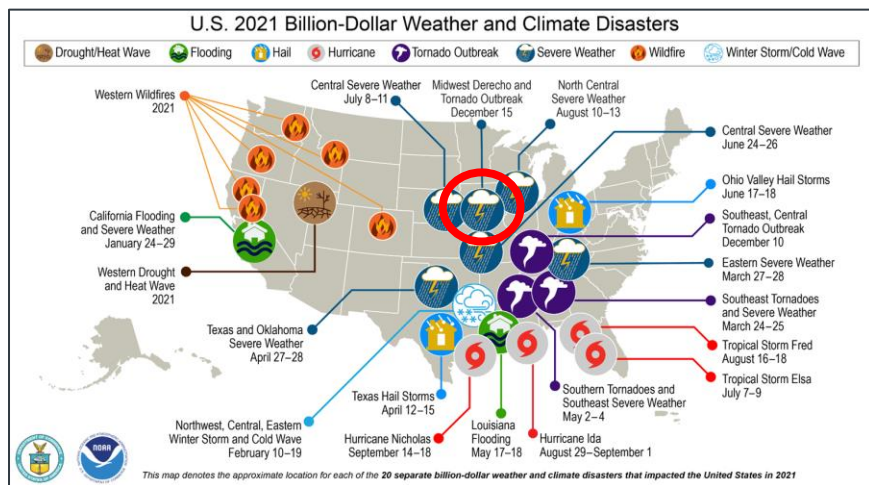
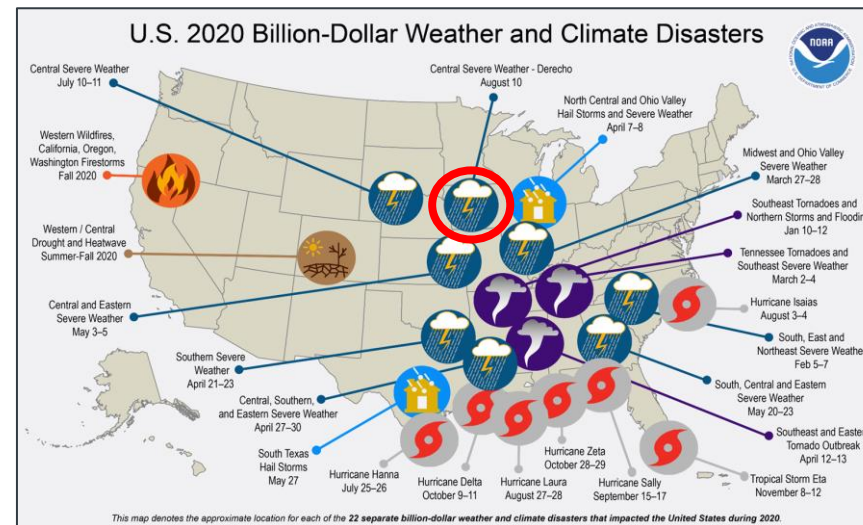
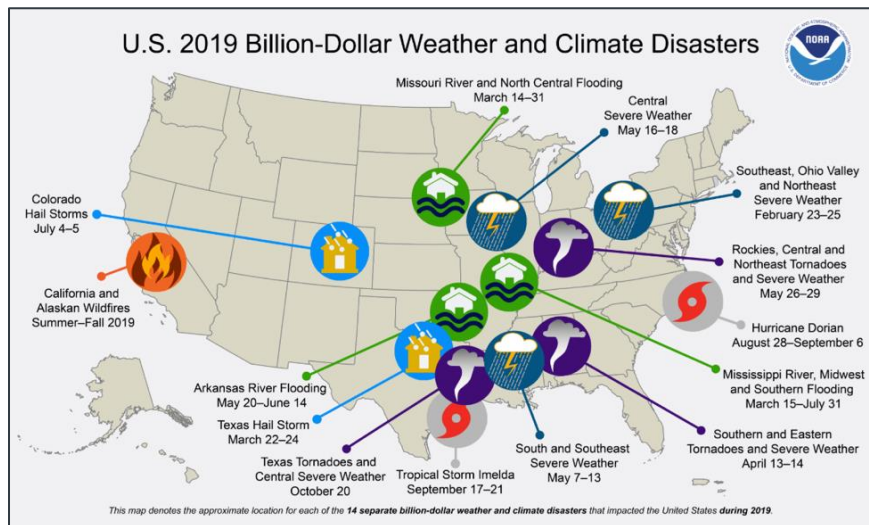


2021



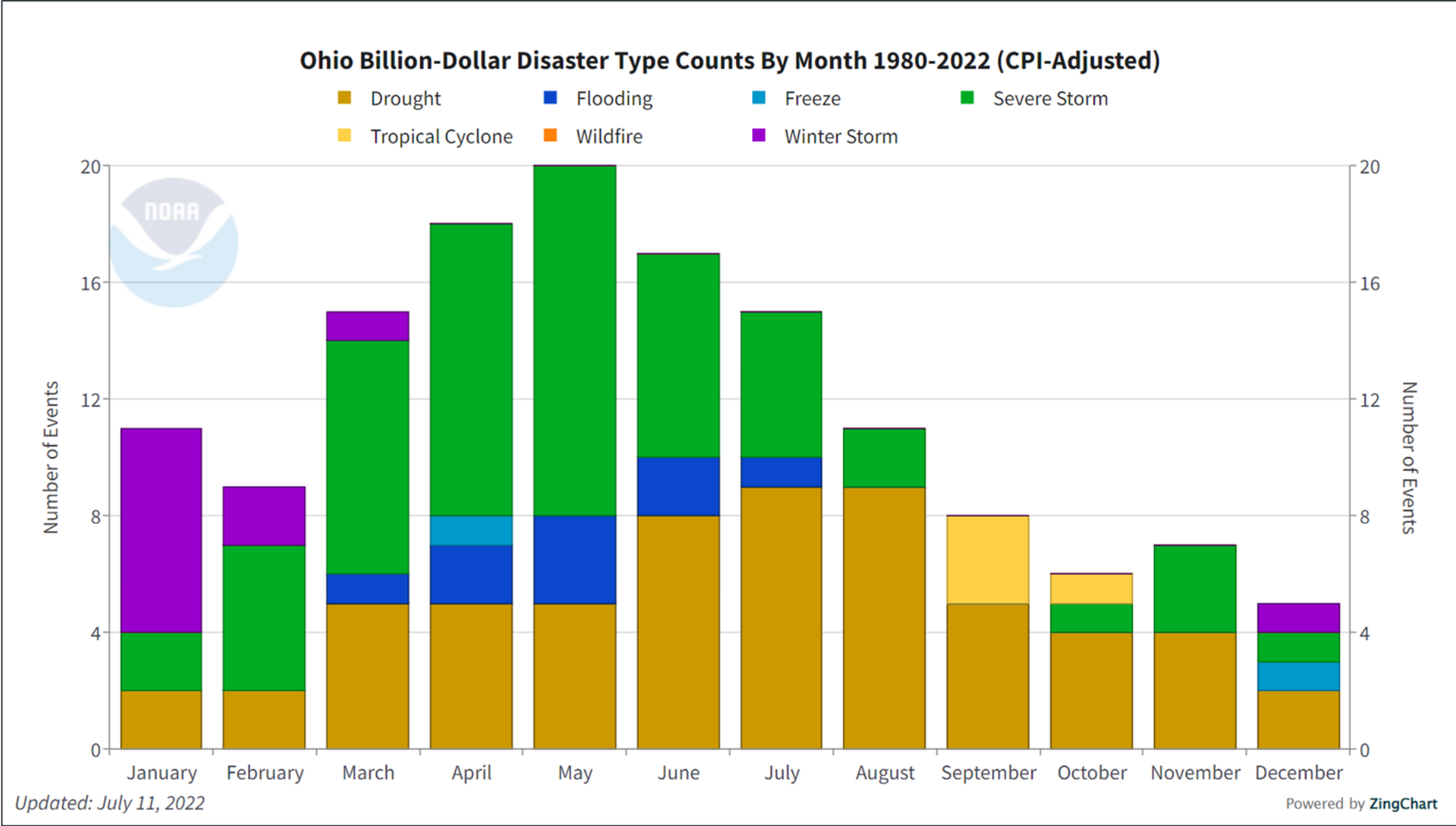


Billion Dollar Disasters - Last Four Years



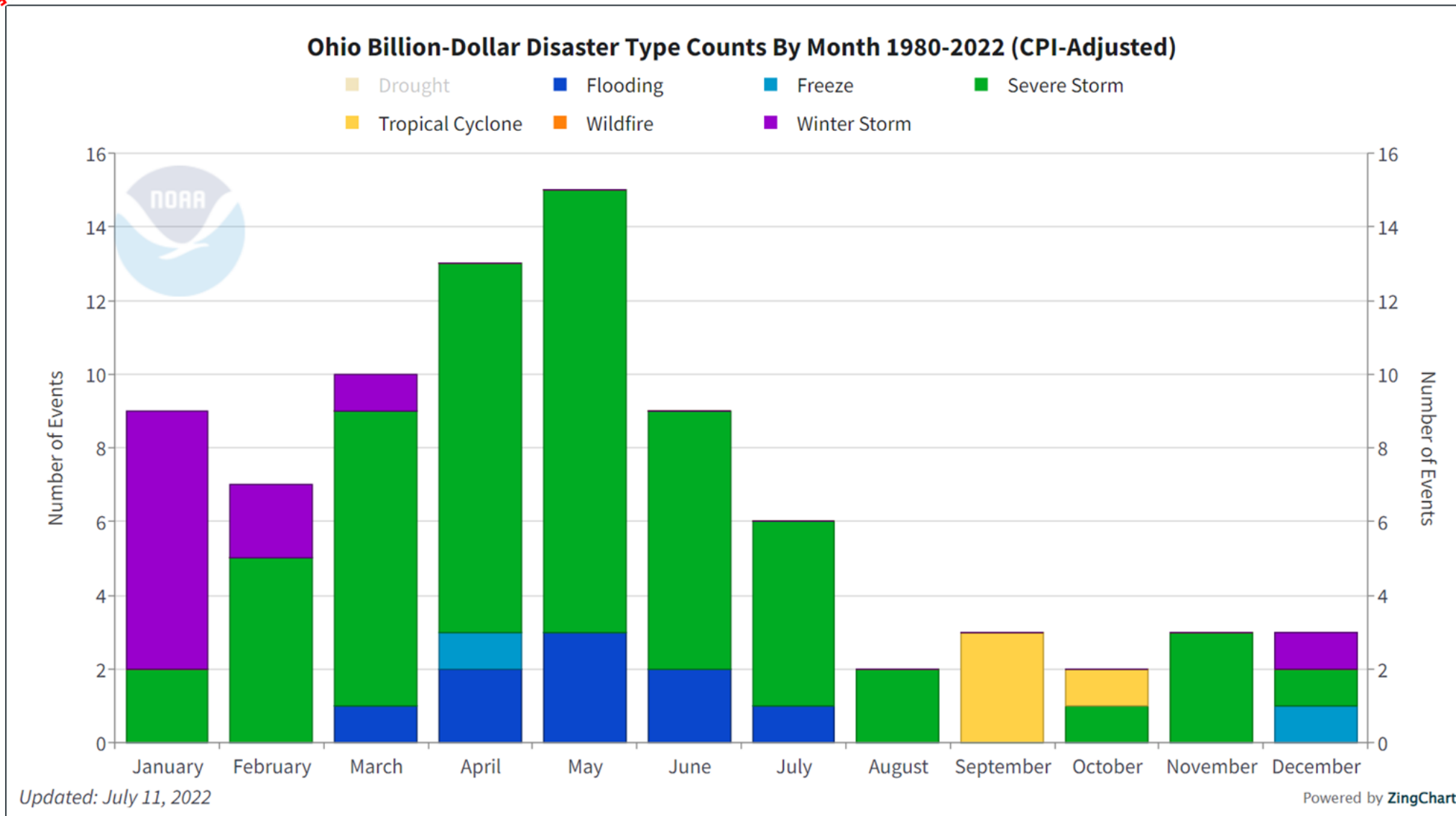


How does each **disaster** rank for Ohio?





How do Severe Storm Events rank for Ohio?





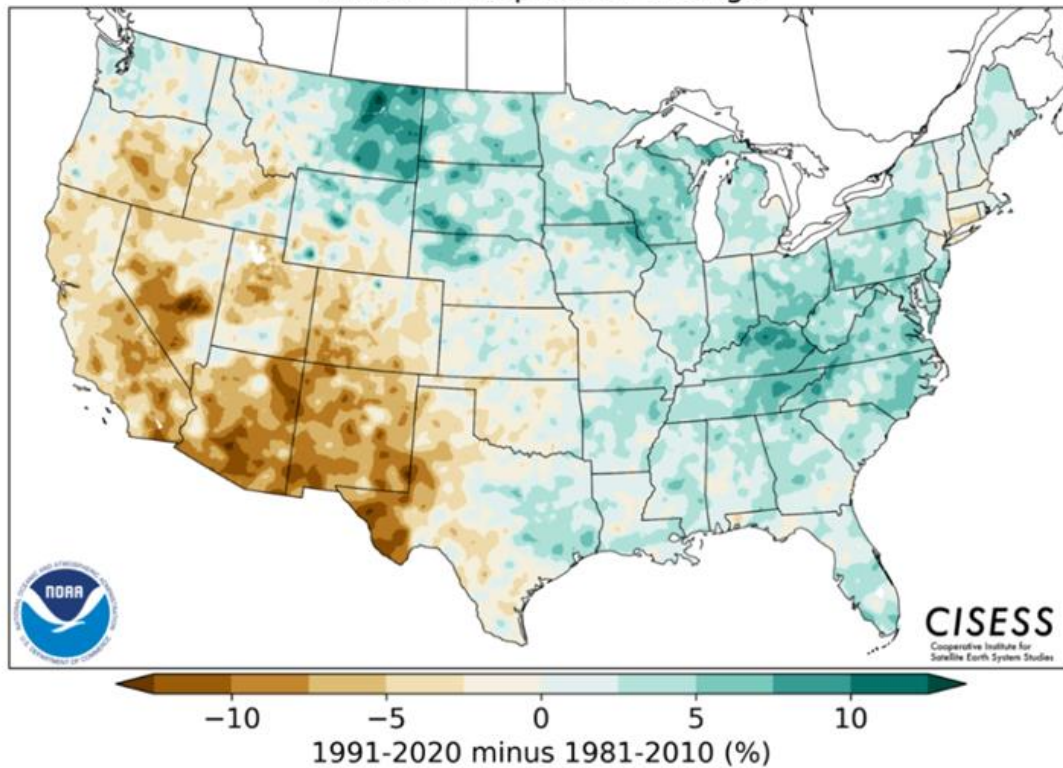
How can climate change weather?



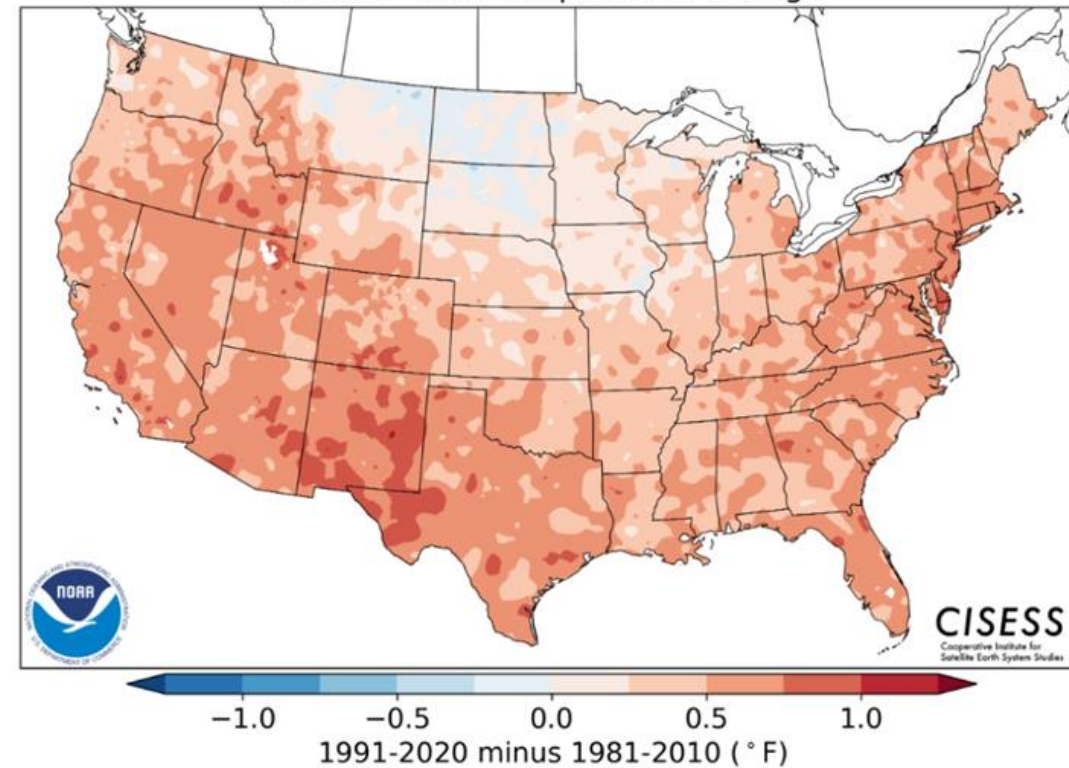
New 30-year climate normals ...



Annual Precipitation Change

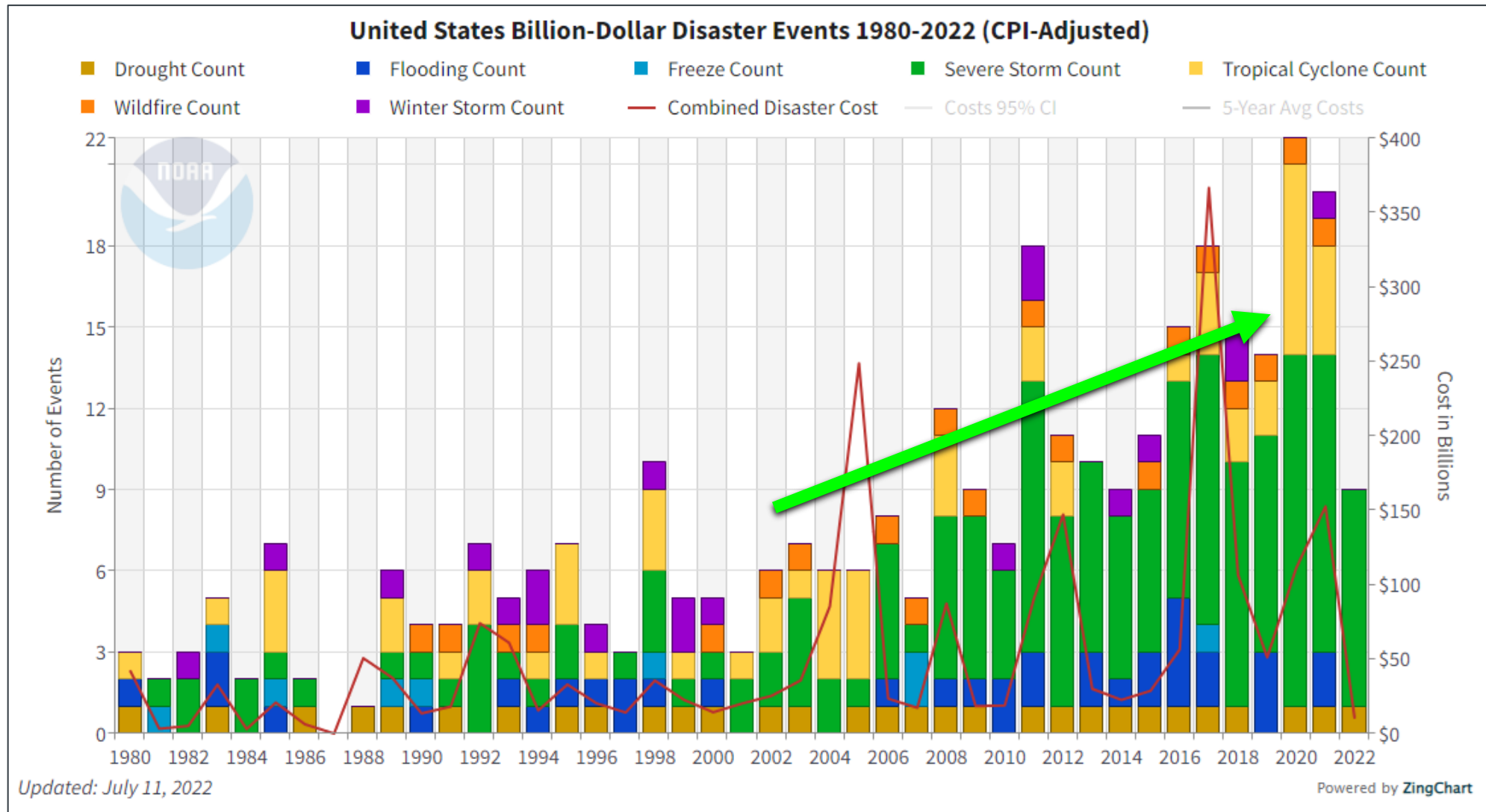


Annual Mean Temperature Change



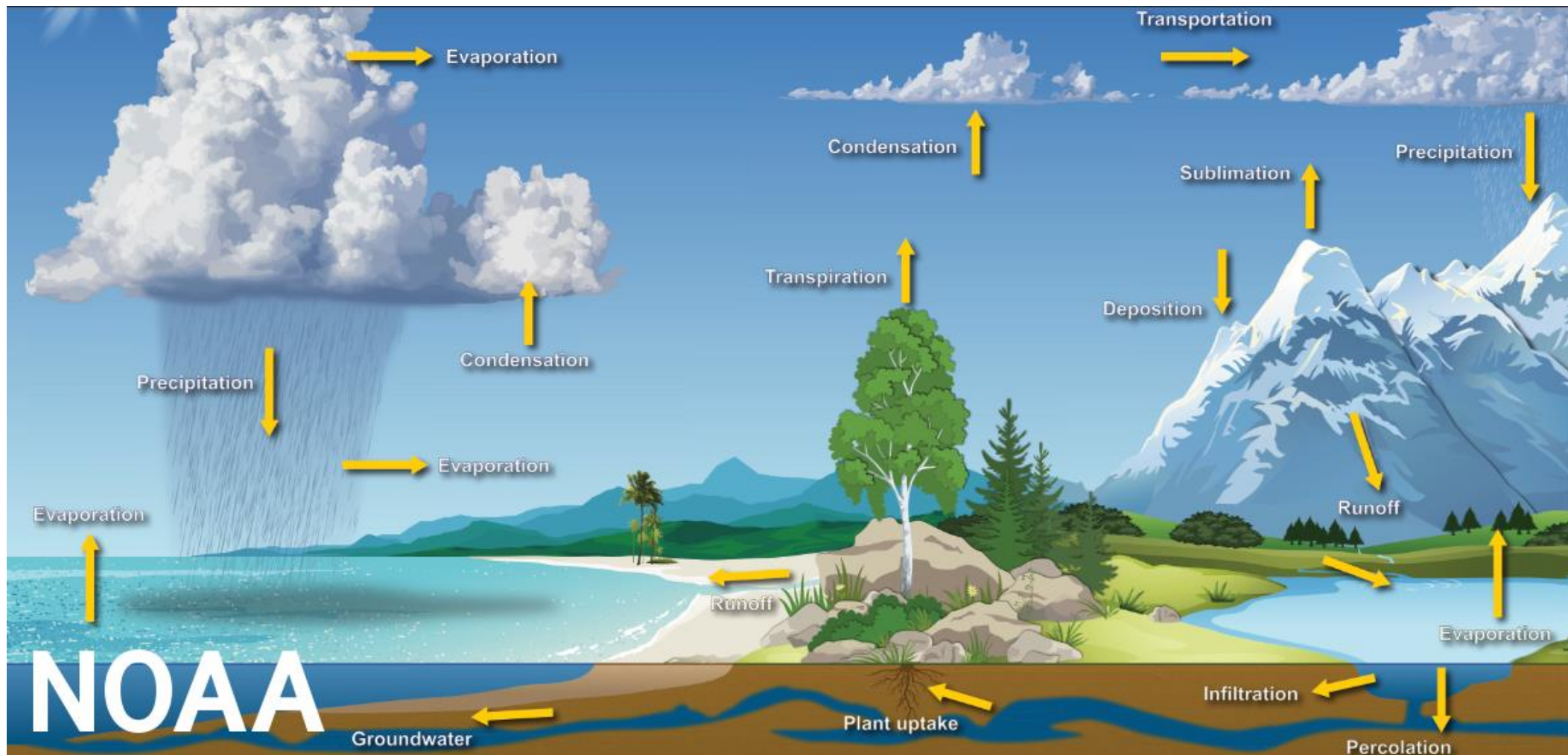


Billion Dollar Disasters Trending UP



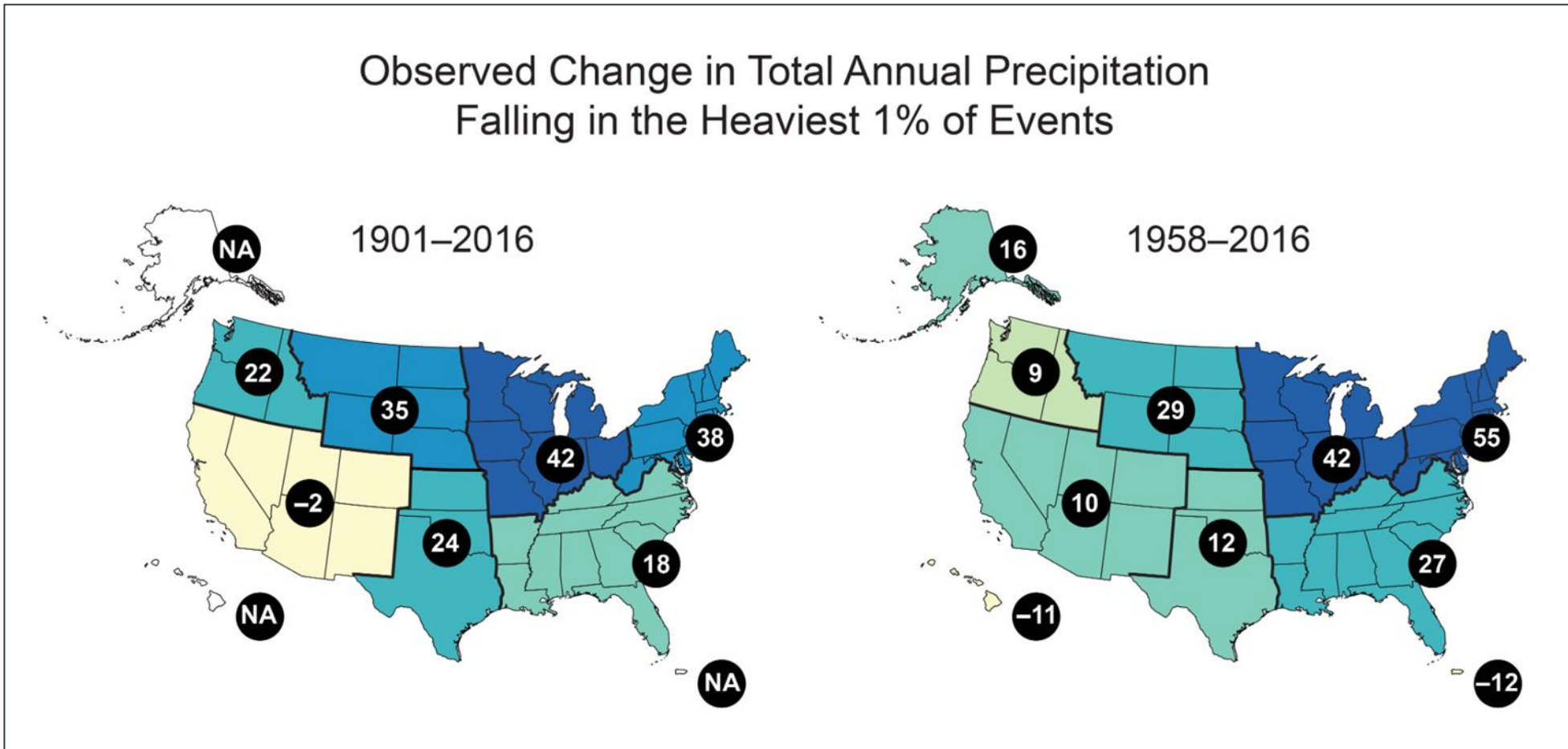


Water is a **BIG** deal...





How are **heavy rainfall** events changing?

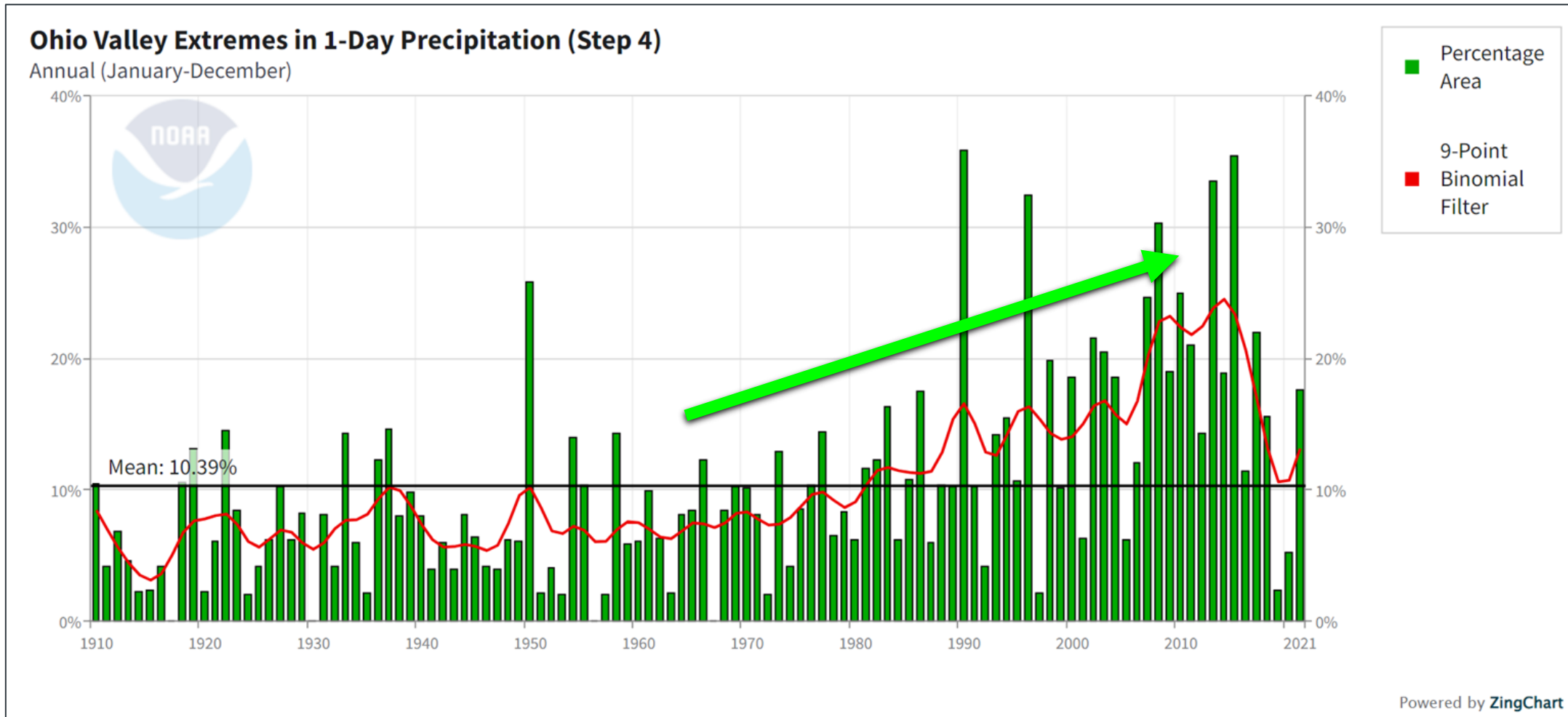


% change is calculated by differences to the 1986-2016 period





How are **heavy rainfall** events changing?

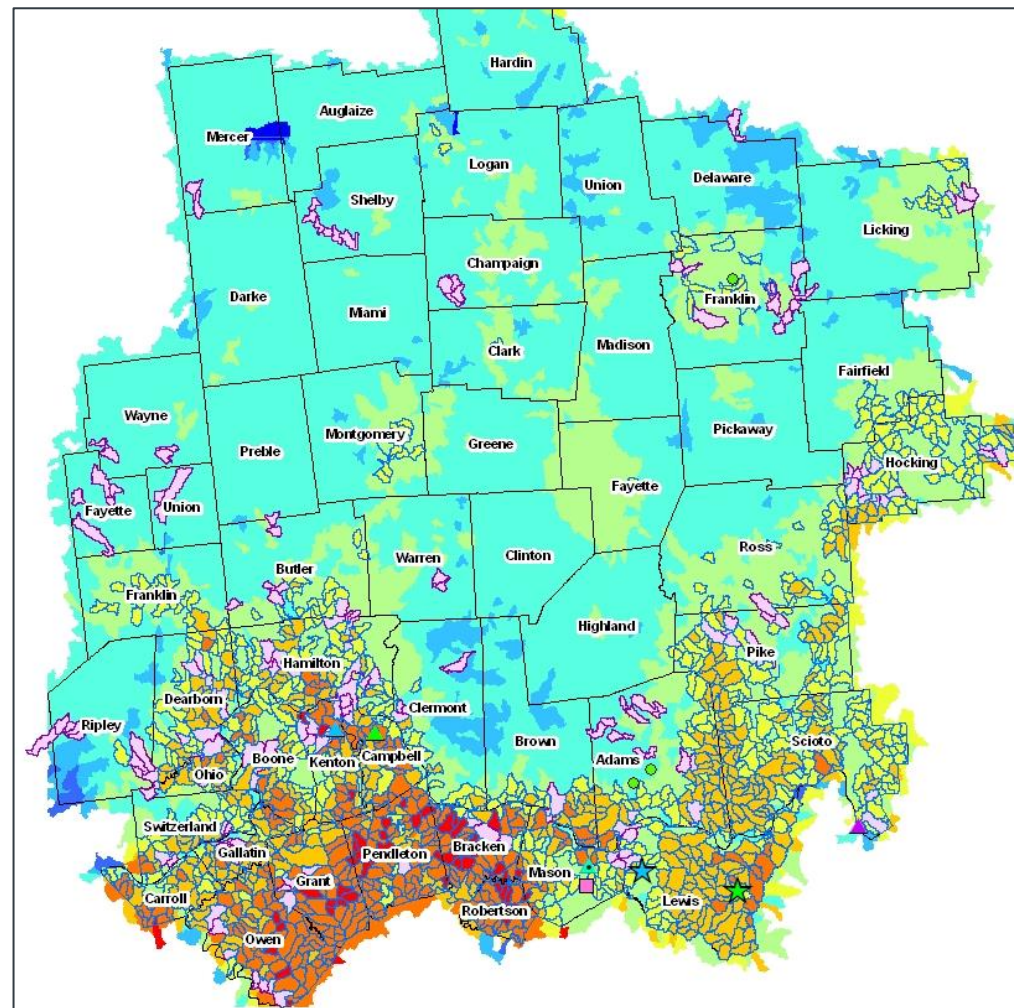
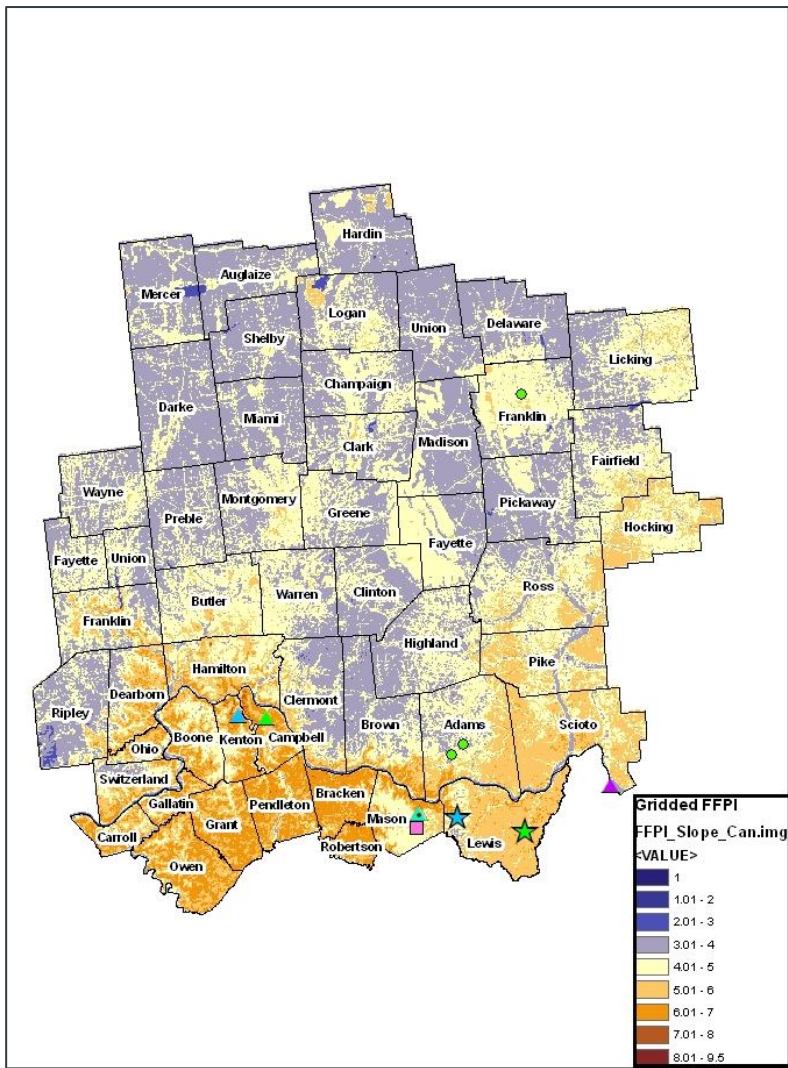


of days where daily observations show extreme precipitation



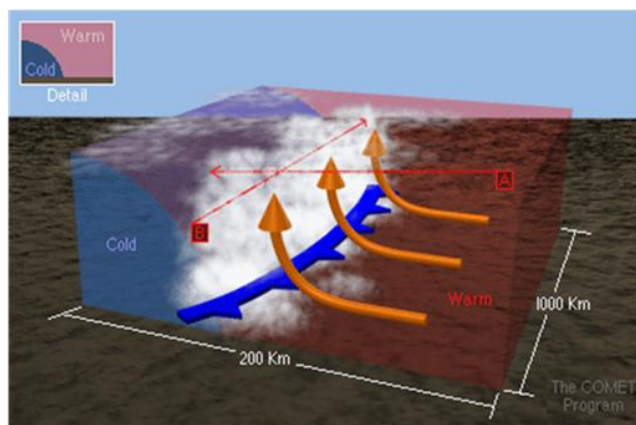
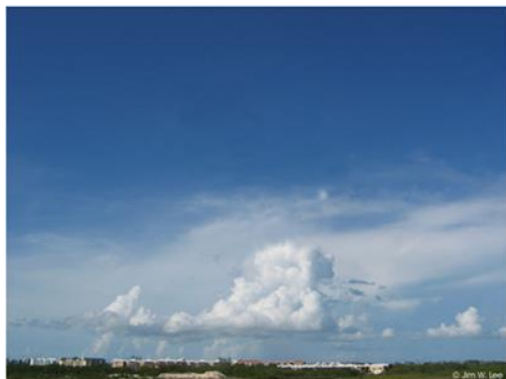


Will more extreme rainfall events lead to **more** flooding?





Why do heat **and** moisture trends matter for weather?



Moisture and Heat work together to create clouds and thunderstorms. This relationship is enhanced when there are lifting features like cold fronts!



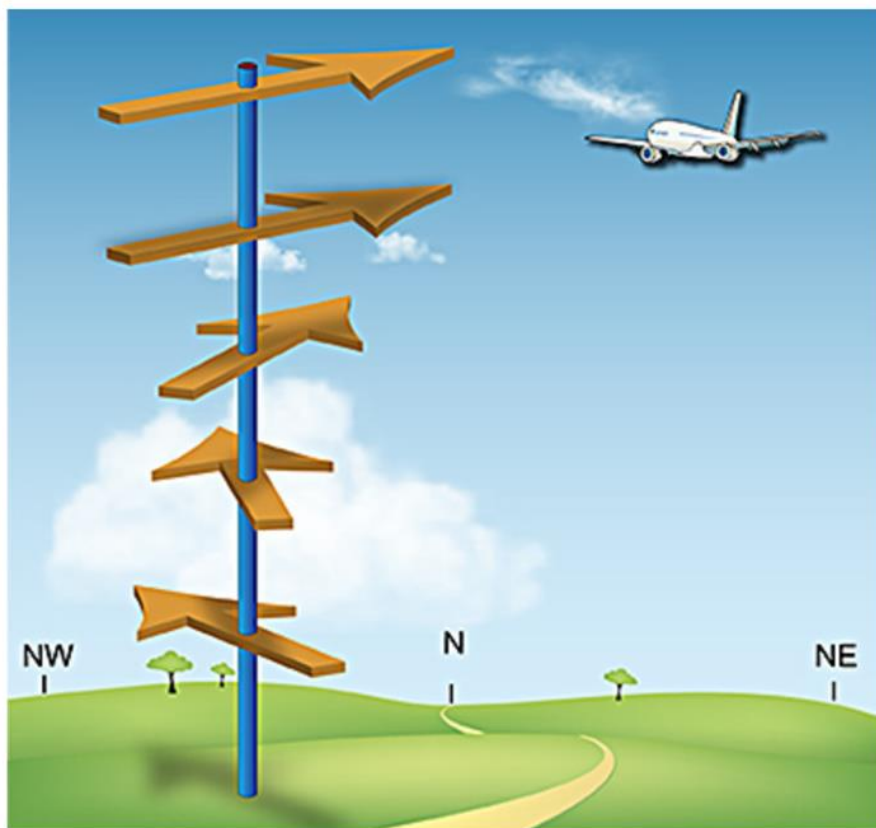


Tornadoes



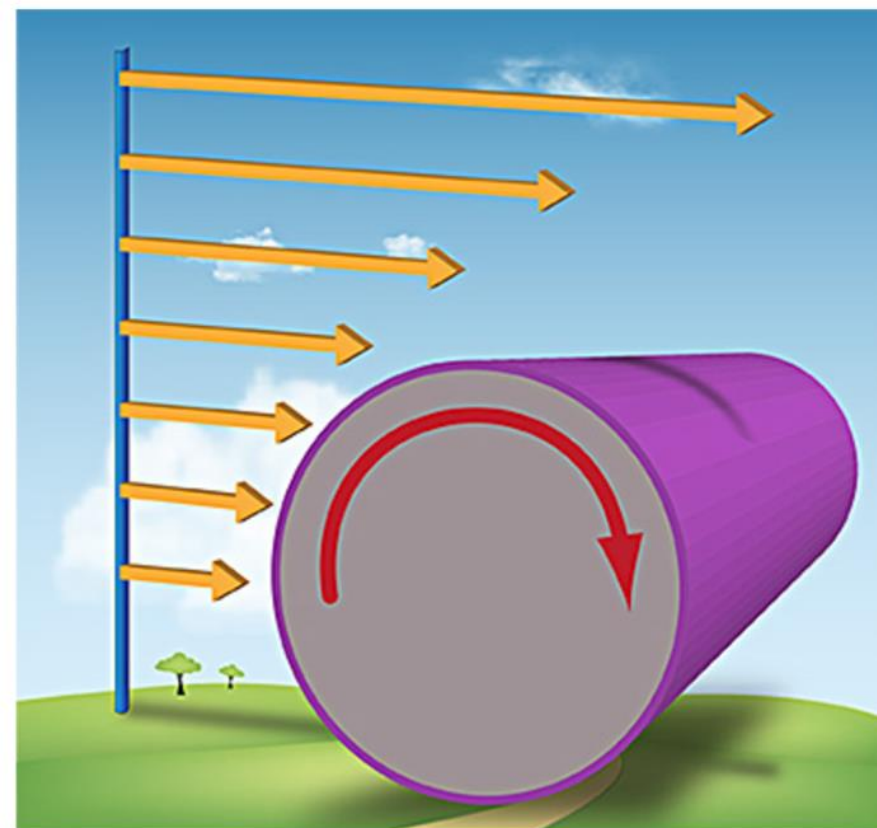
For organized storms, there is an additional ingredient called **wind shear** that is typically required

Directional Shear



Wind **direction** changes with height

Speed Shear

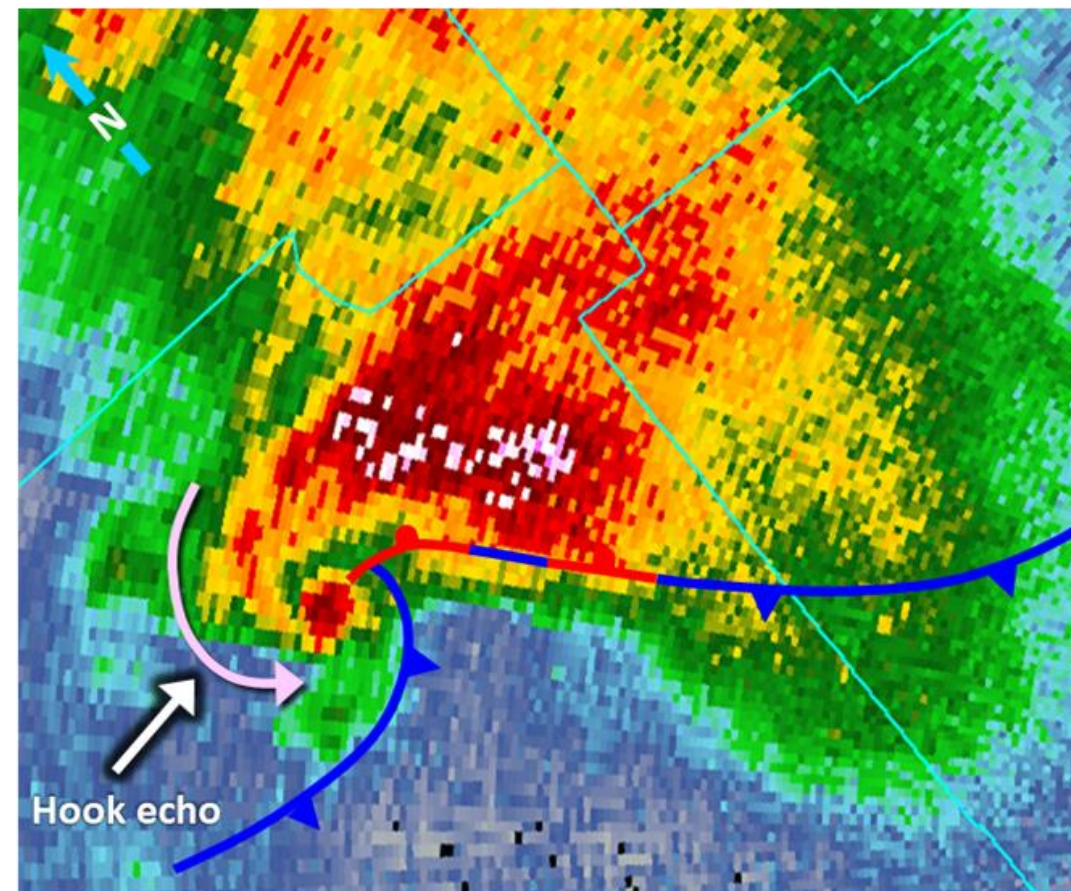
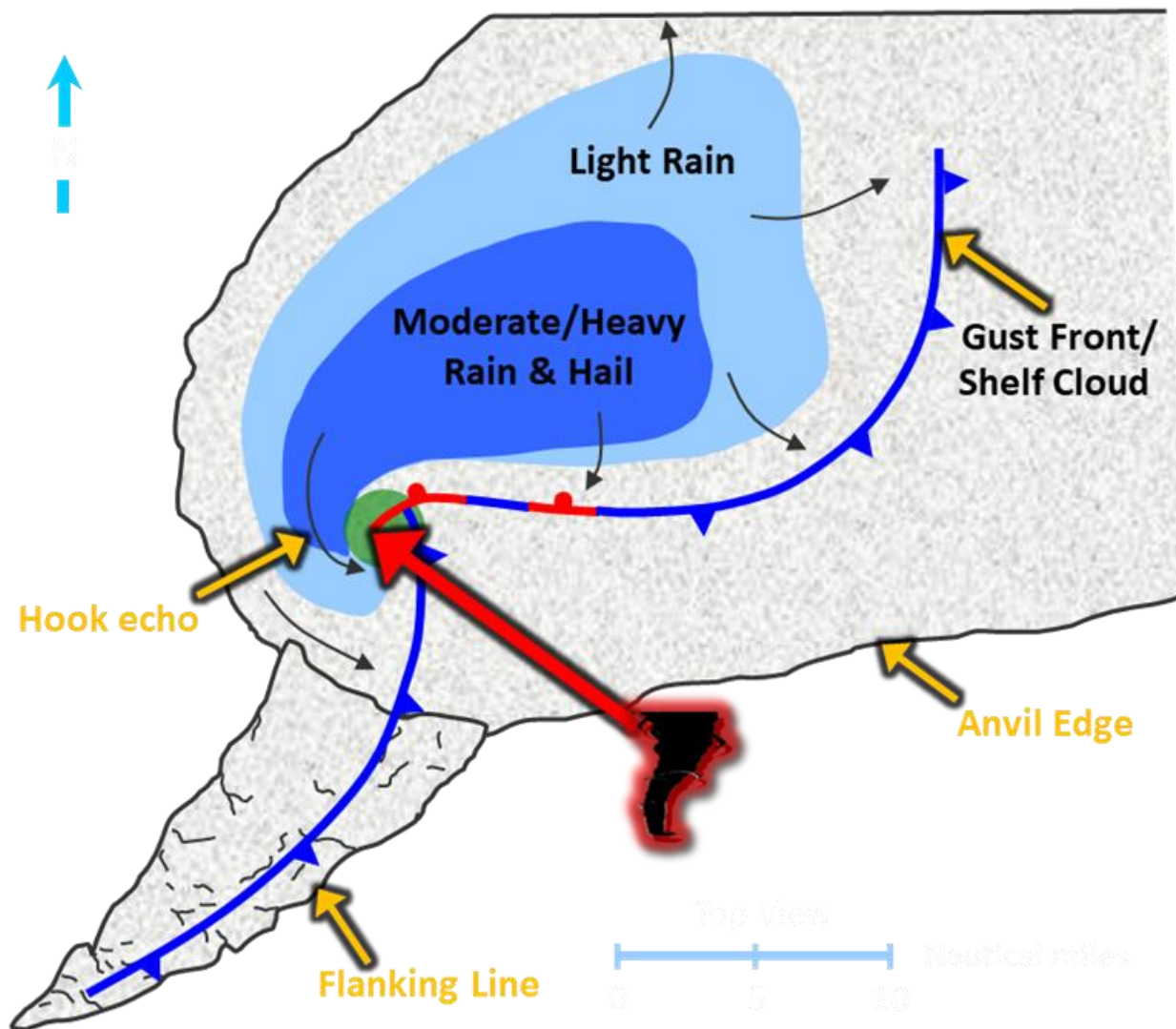


Wind **speed** changes with height.





Tornadoes

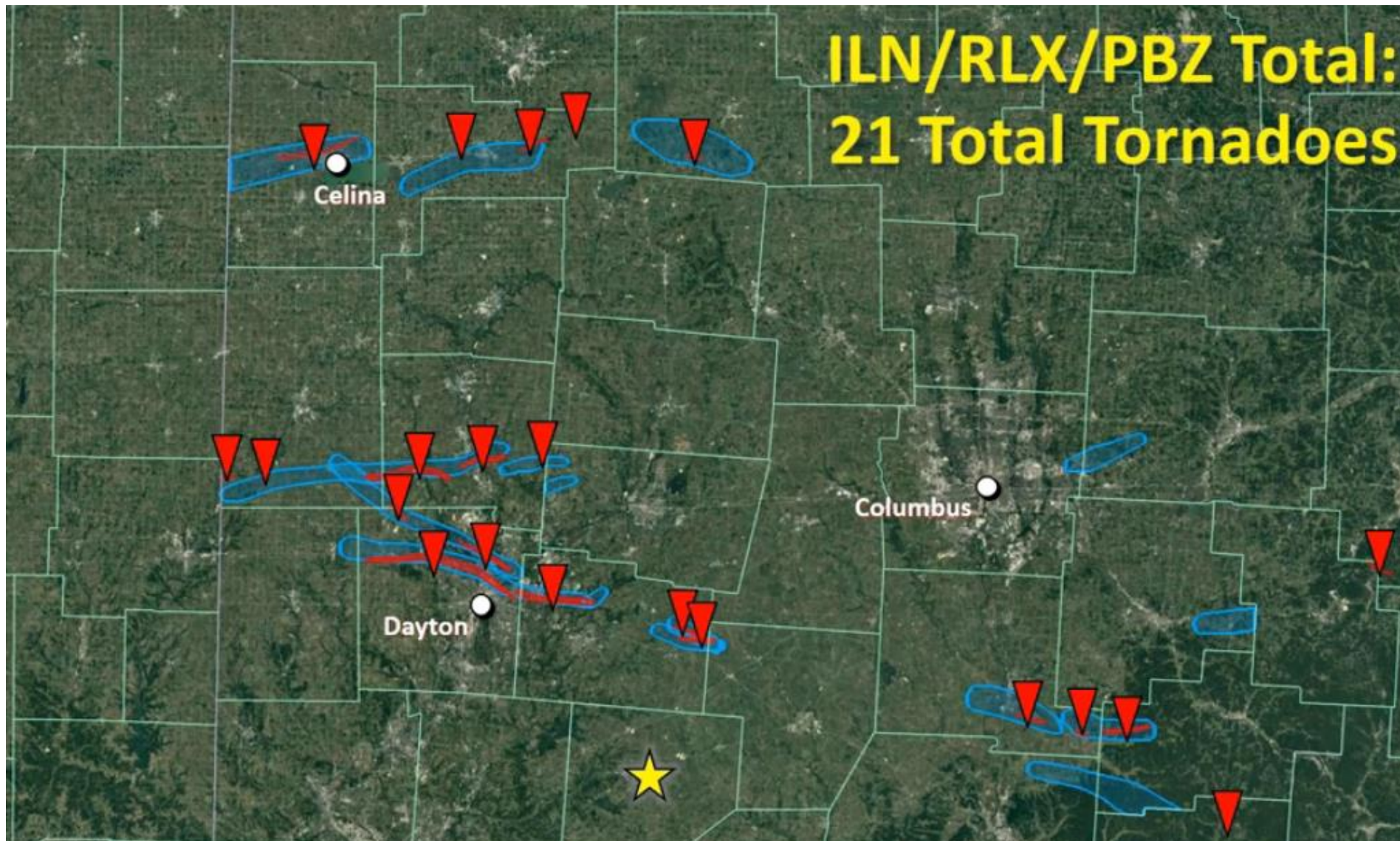


Montgomery County OH Supercell
May 27, 2019



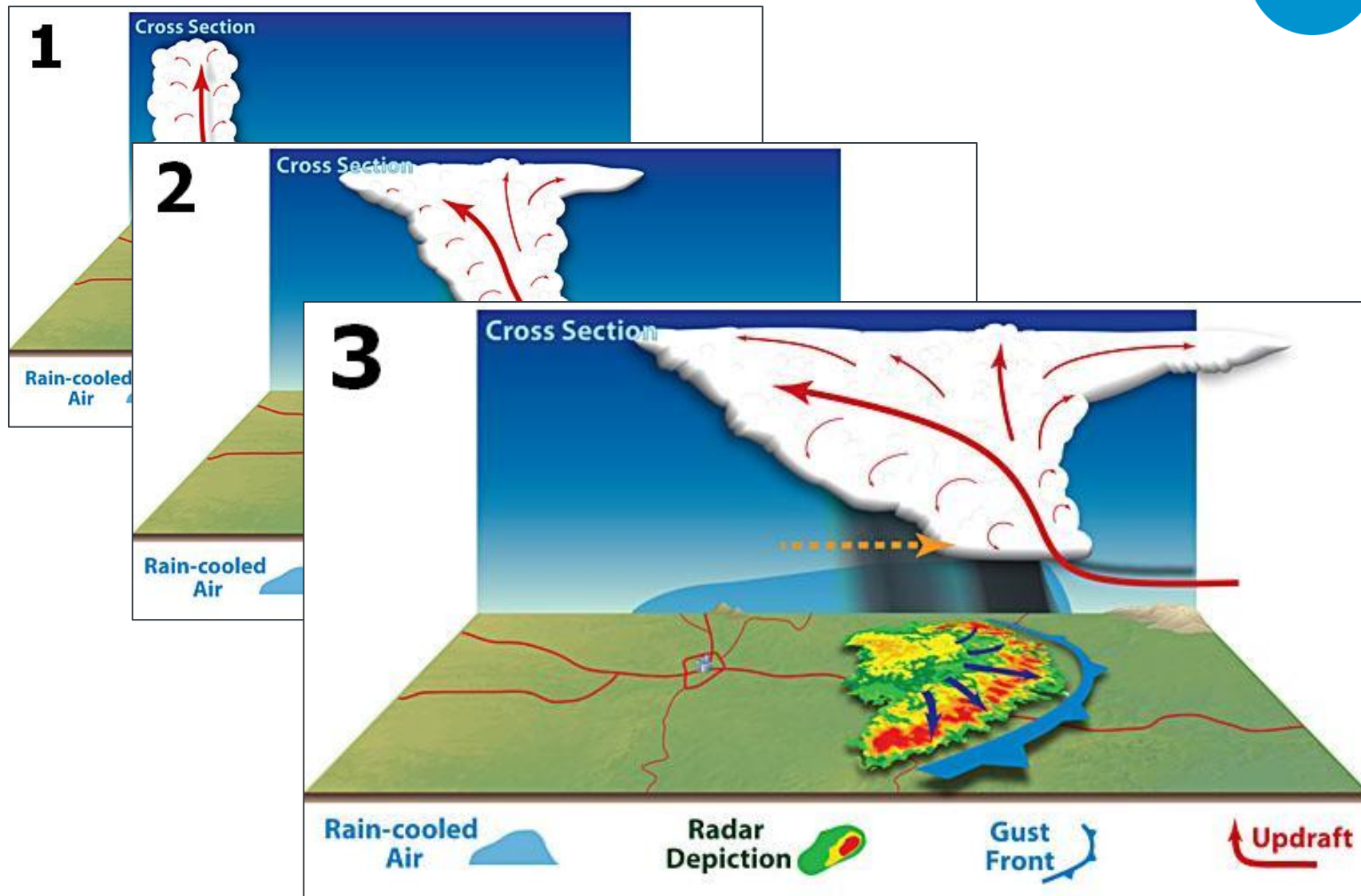
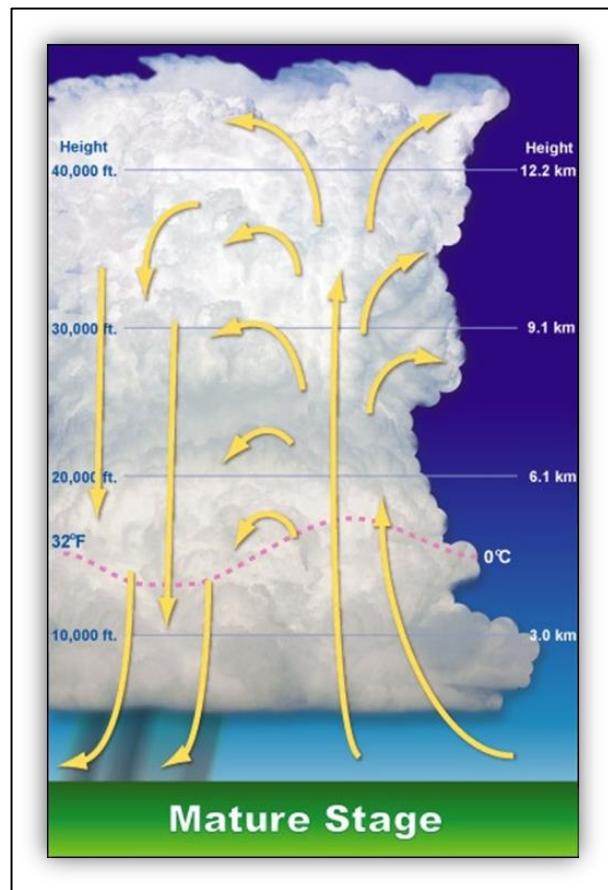


Remembering the Memorial Day 2019 Outbreak



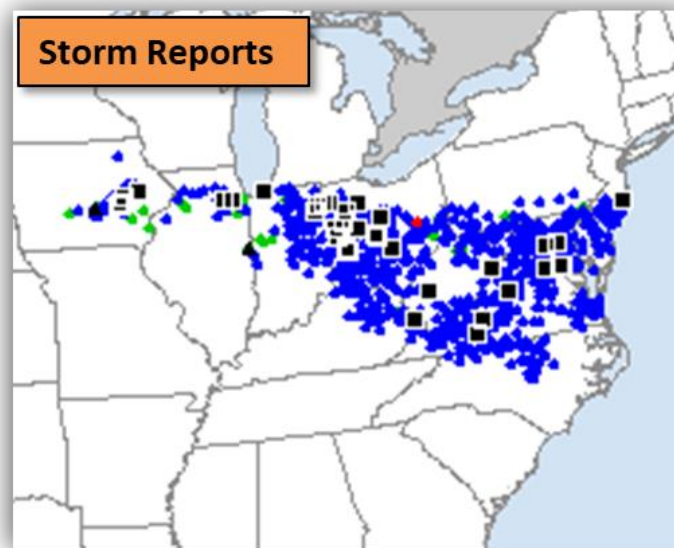
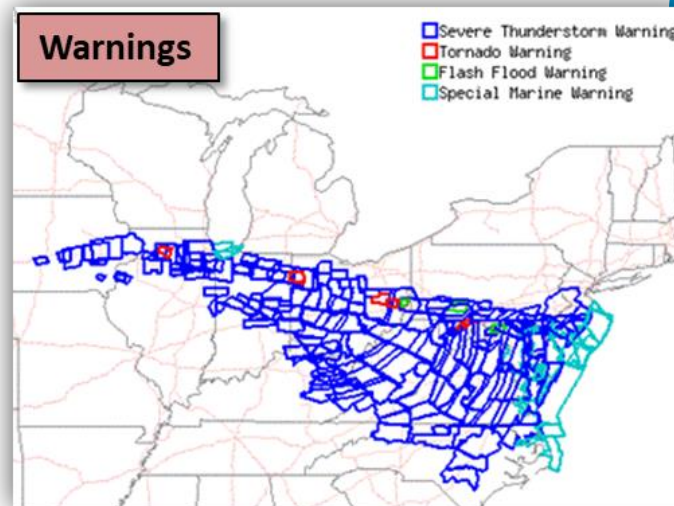
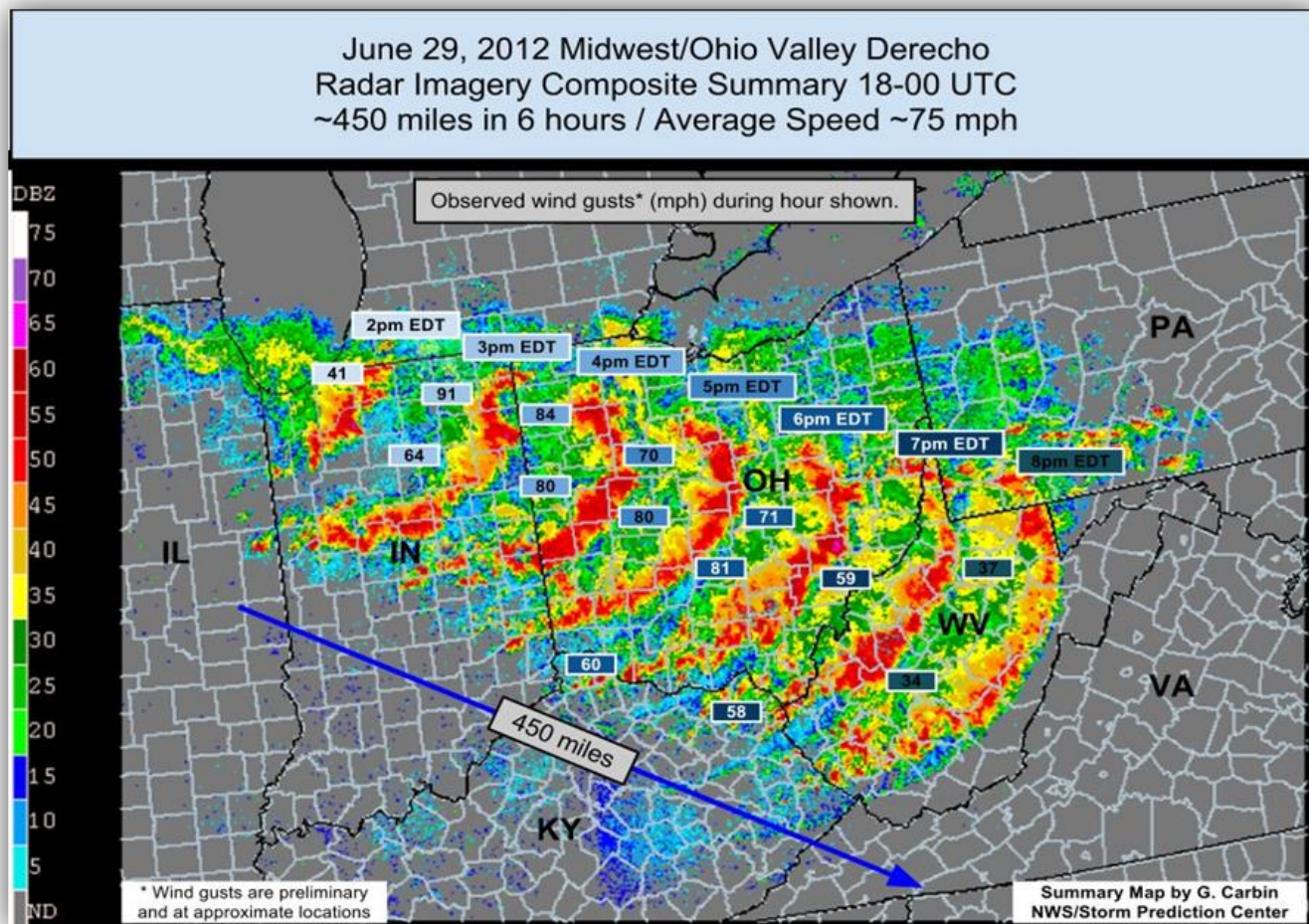


The Derecho



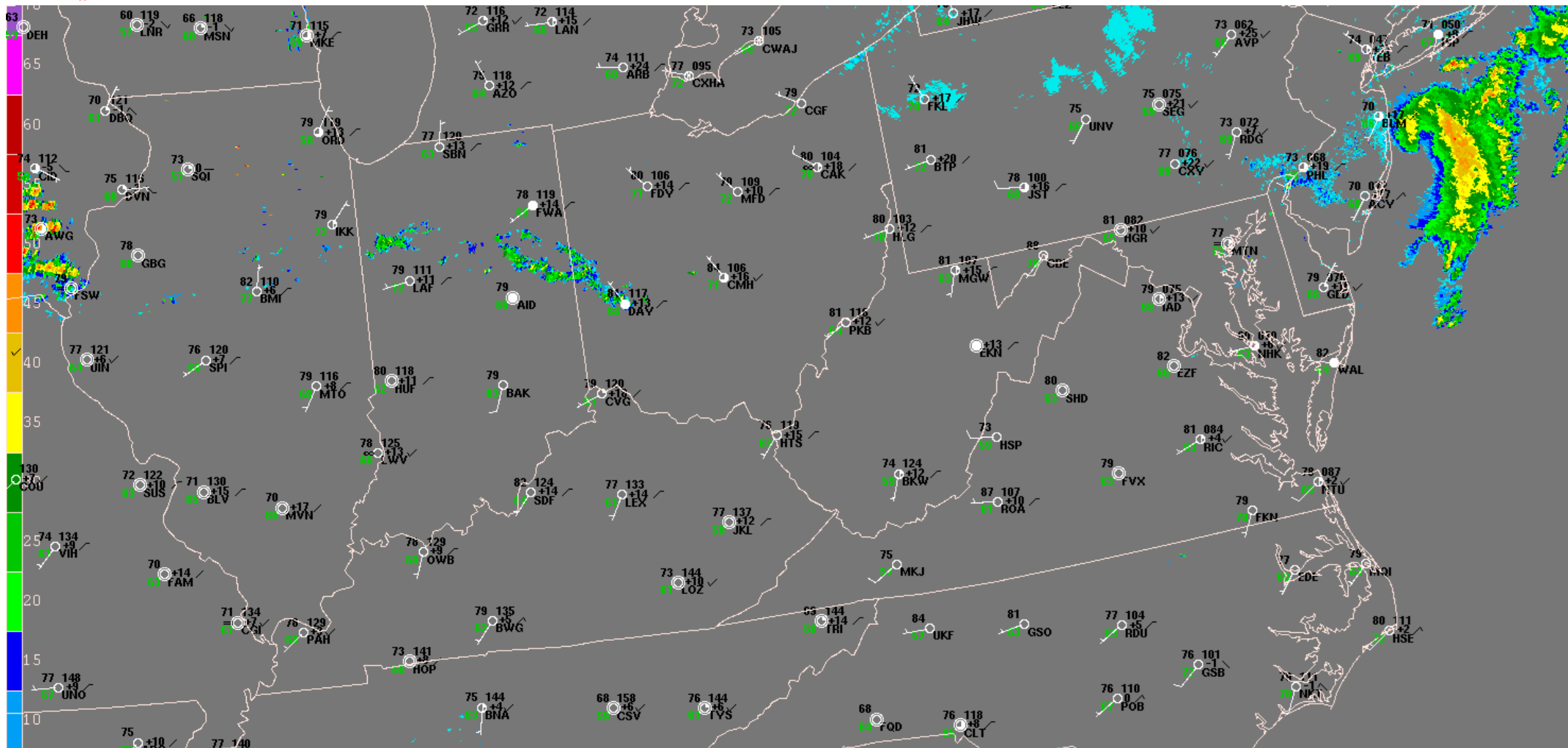


The 2012 Derecho





The 2012 Derecho Radar Loop



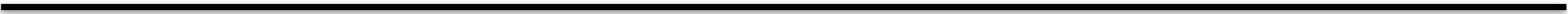


Wrapping It up...



With regards to climatology, time and size scales matter...

1 month



Droughts



Heat / Cold Waves



Hurricanes / Floods



Severe Thunderstorms



Tornadoes





Thank you!

Off to you Geddy!





Weather, Climate, & Climate Change – Central Ohio and Beyond

Geddy R. Davis
Byrd Center & SCOO
6 April 2023



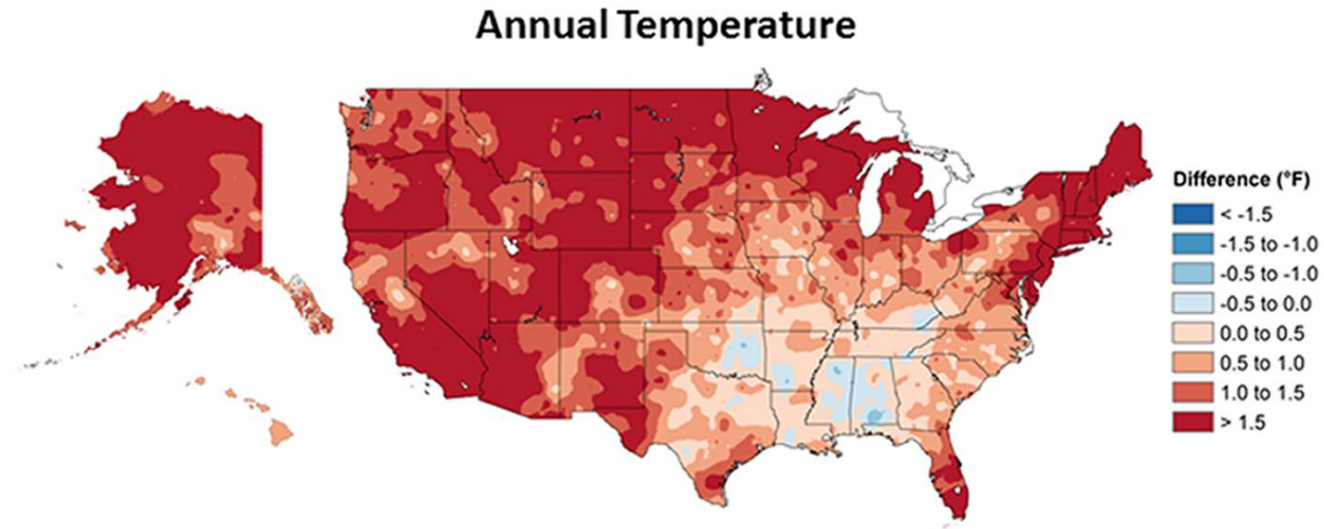
THE OHIO STATE UNIVERSITY

Introduction

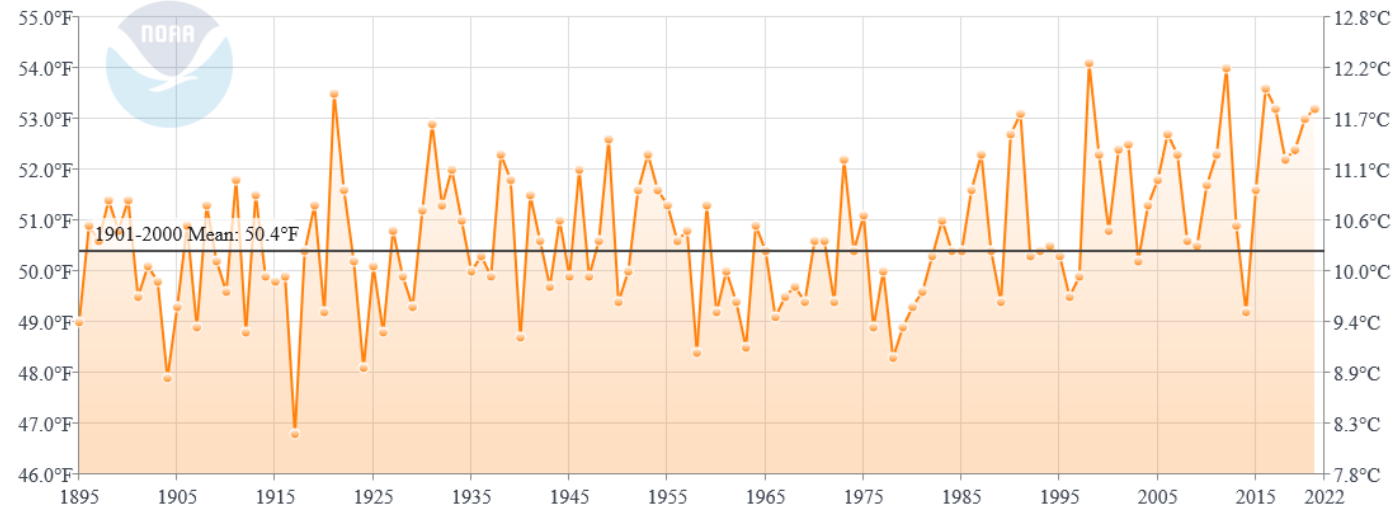
- Geddy Davis – Weather & Climate Services Program Coordinator (Byrd Polar & Climate Research Center).
 - B.S. Atmospheric Science – Ohio State University (May '22)
 - Cert. Of Weather Forecasting – Penn State University (Dec '20)
- Partner with State Climate Office of Ohio (SCOO) in sharing weather and climate information to Ohioans
- Science and records (SCOO) + education/outreach (Byrd) = fruitful connections, programs, and partnerships



Ohio Temperature Assessment



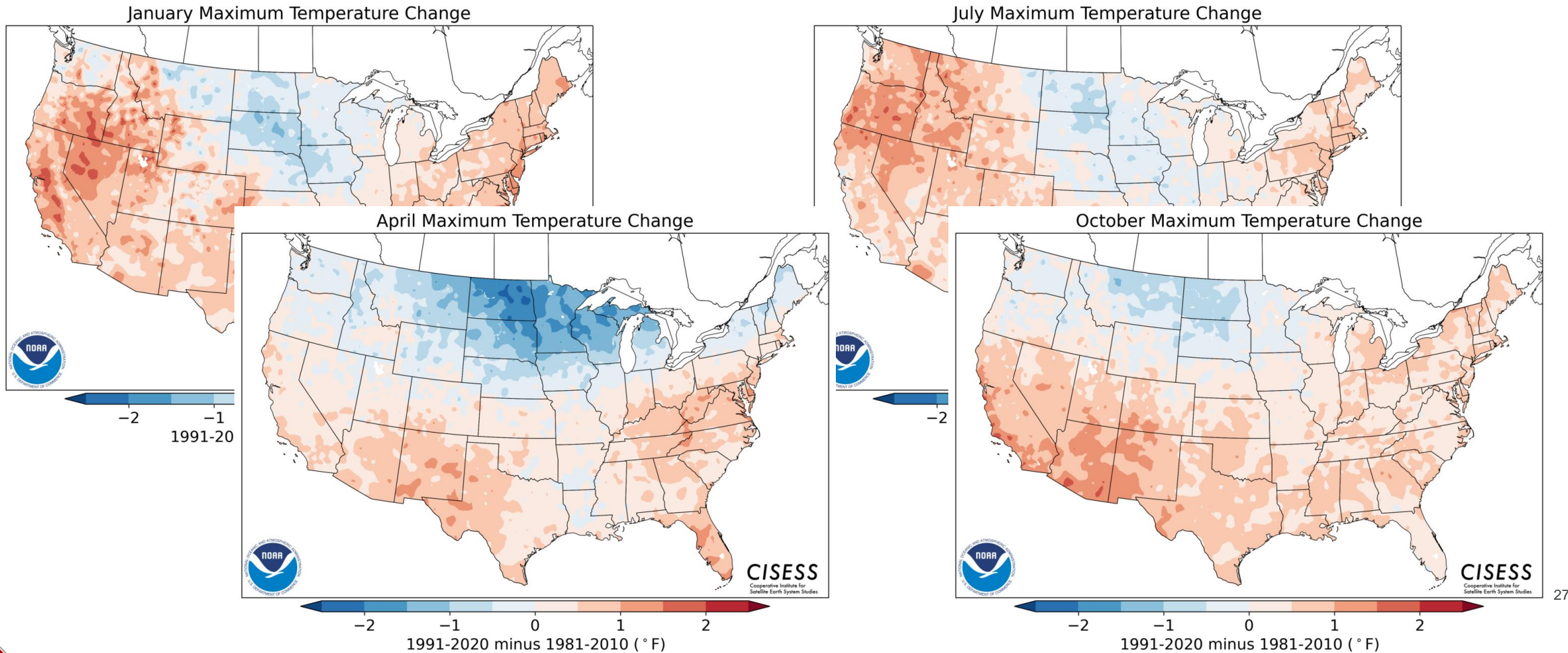
Ohio Average Temperature
January-December



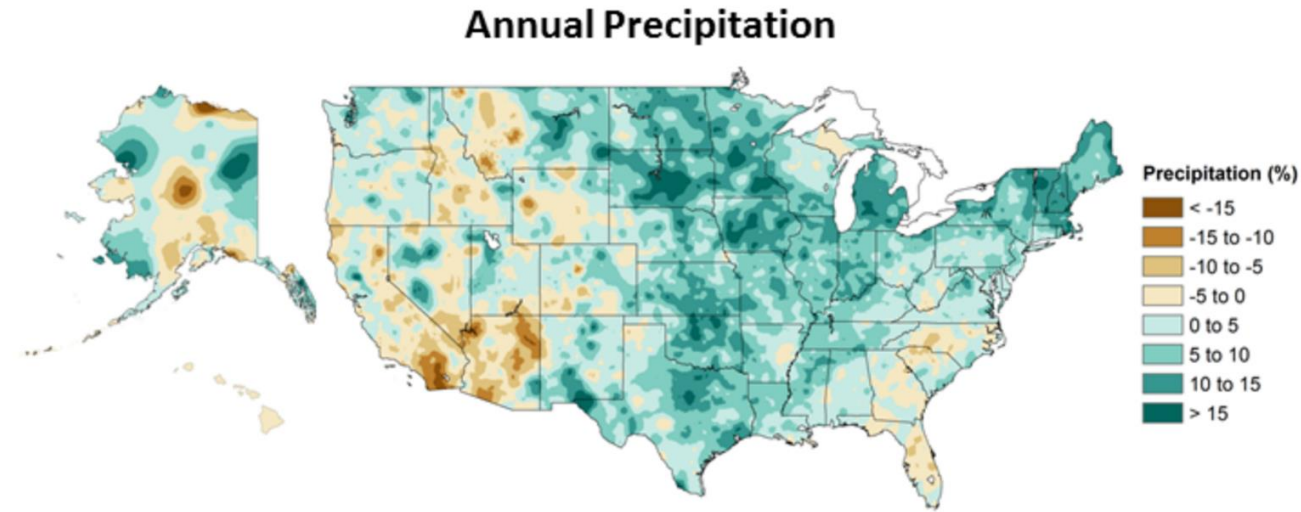
- More than 95% of the land surface demonstrated an increase in annual average temperature
- Trend in Ohio is 0.1°F per decade 1895-2020
- Greatest and most widespread in winter



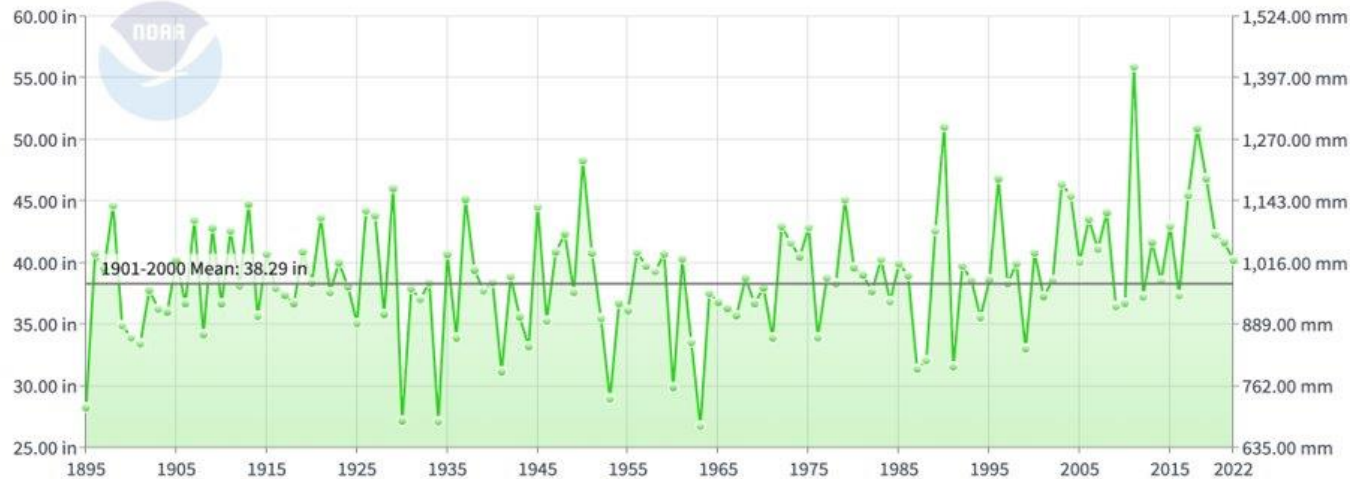
Seasonal Temperature Changes



Ohio Precipitation Assessment



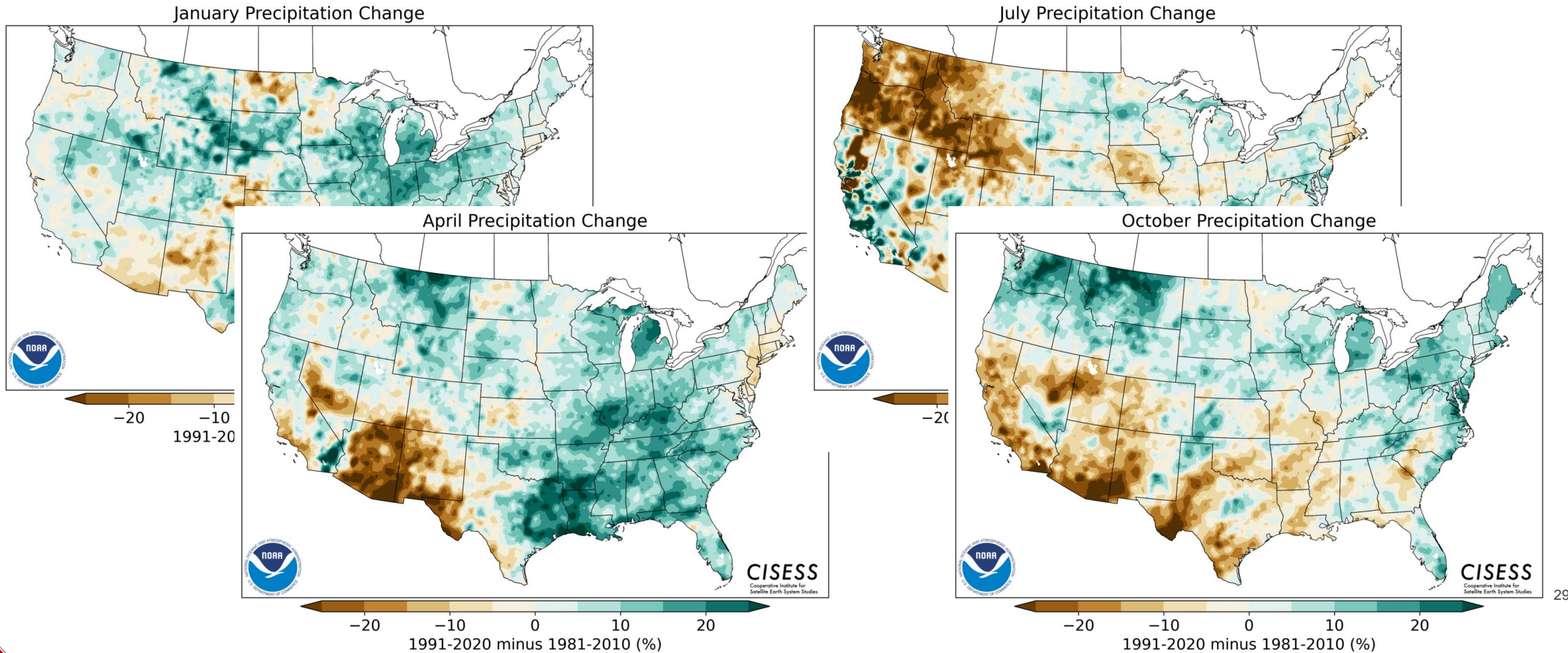
Ohio Precipitation
January-December



- National average increase of 4% since 1901
- Trend in Ohio is 0.31" per decade 1895-2020
- Includes changes to seasonal trends and intensity



Seasonal Precipitation Changes



Top 10 Warmest & Wettest Years in Ohio

TEMPERATURE			
RANK	YEAR	AVERAGE	DIFFERENCE
1	1998	54.1	2.4
2	2012	54.0	2.4
3	2016	53.6	1.9
4	1921	53.5	1.8
5	2017	53.2	1.6
5	2021	53.2	1.6
7	1991	53.1	1.5
8	2020	53.0	1.4
9	1931	52.9	1.3
10	2006/1990	52.7	1.0

PRECIPITATION			
RANK	YEAR	TOTAL	DIFFERENCE
1	2011	55.95	14.85
2	1990	51.07	9.97
3	2018	50.93	9.83
4	1950	48.34	7.24
5	2019	46.87	5.77
6	1996	46.85	5.75
7	2003	46.42	5.32
8	1929	46.07	4.97
9	2017	45.51	4.41
10	2004	45.45	4.35

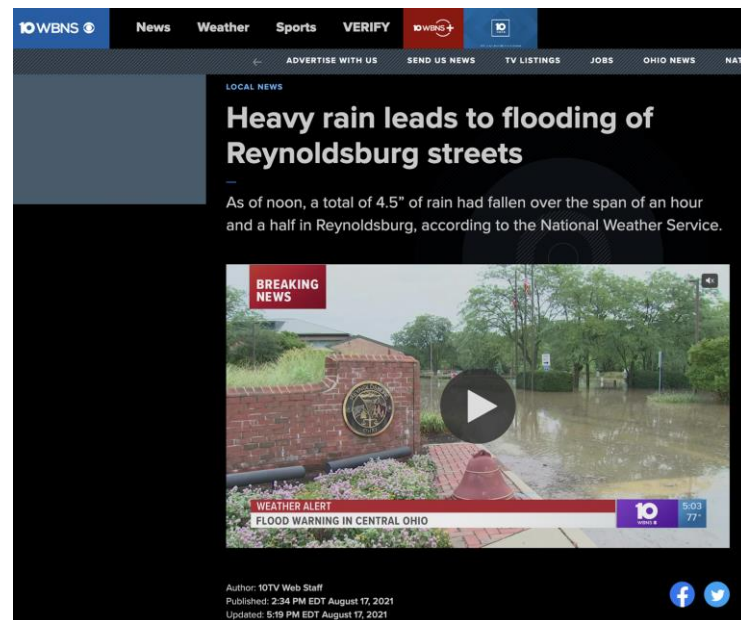


Urban Flooding

May 19, 2020:
Columbus



August 17, 2021:
Reynoldsburg



July 6, 2022:
Columbus

Columbus and Central Ohio Weather

COLUMBUS, Ohio (WCMH) – Rainfall totals from storms Tuesday and Wednesday came in the running for the most in 143 years in central Ohio.

As additional on-and-off showers loom for Friday, Storm Team 4 compiled rainfall totals for the last three days. Wednesday was the fourth wettest day in Columbus records since 1879, with a total rainfall of 3.70 inches at John Glenn Columbus International Airport. Adding up the rainfall on Tuesday and Wednesday, Columbus ended up receiving 4.56 inches.

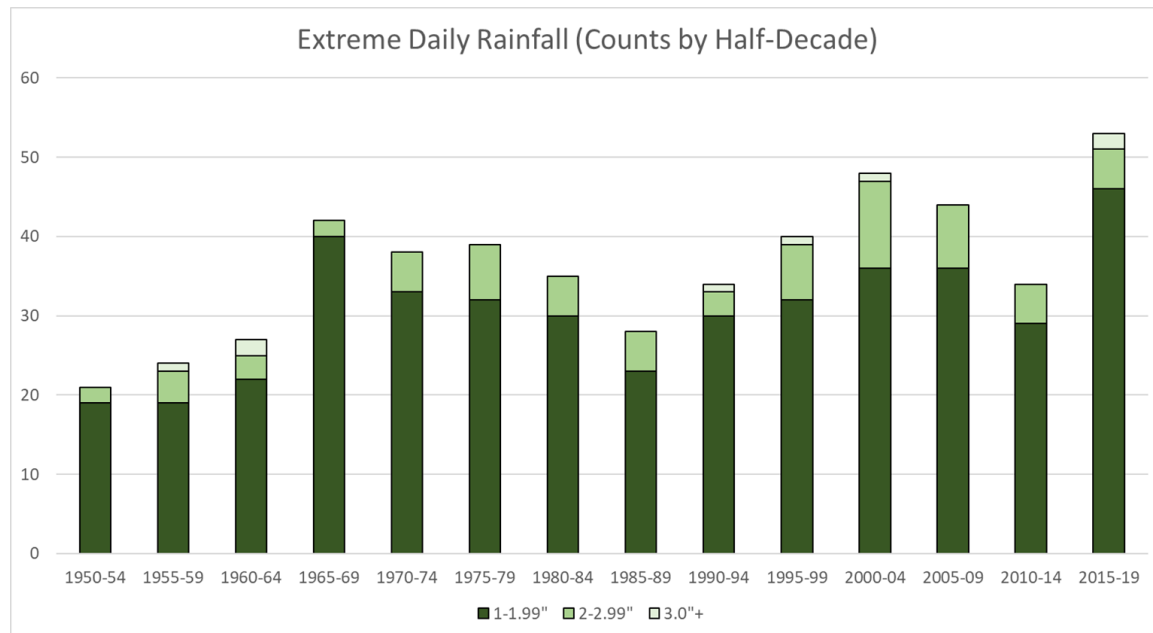


[OhioHealth laying off more than 600 workers for outsourcing plan](#)

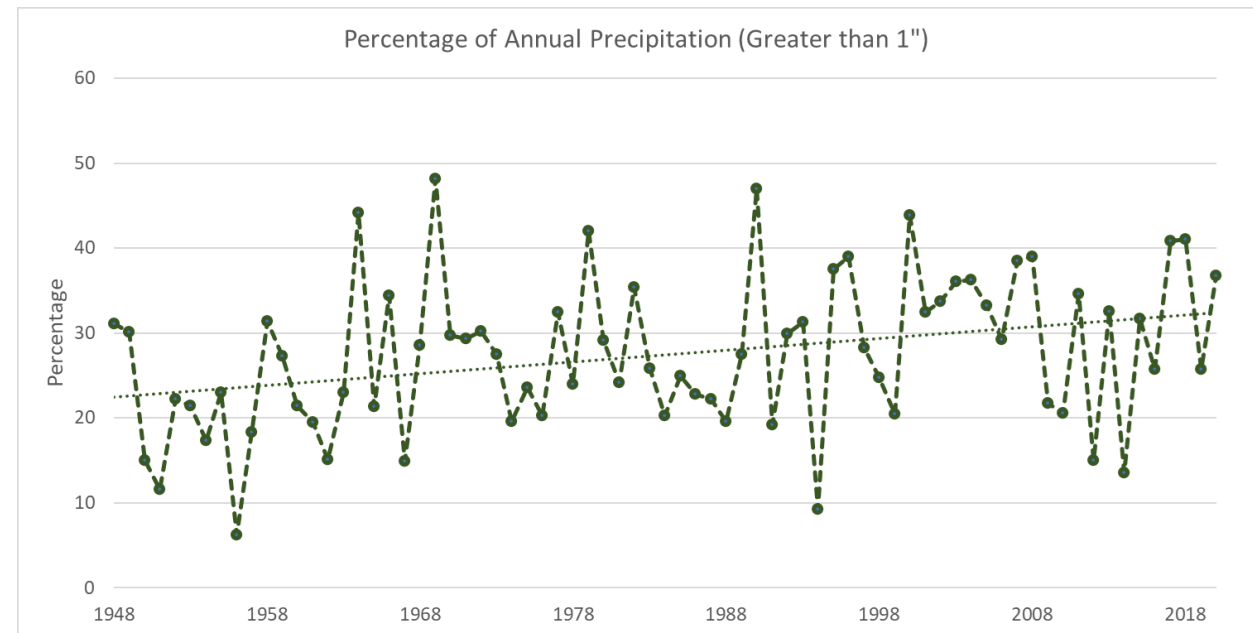
Urban Flooding



Precipitation Intensity Changes in Columbus

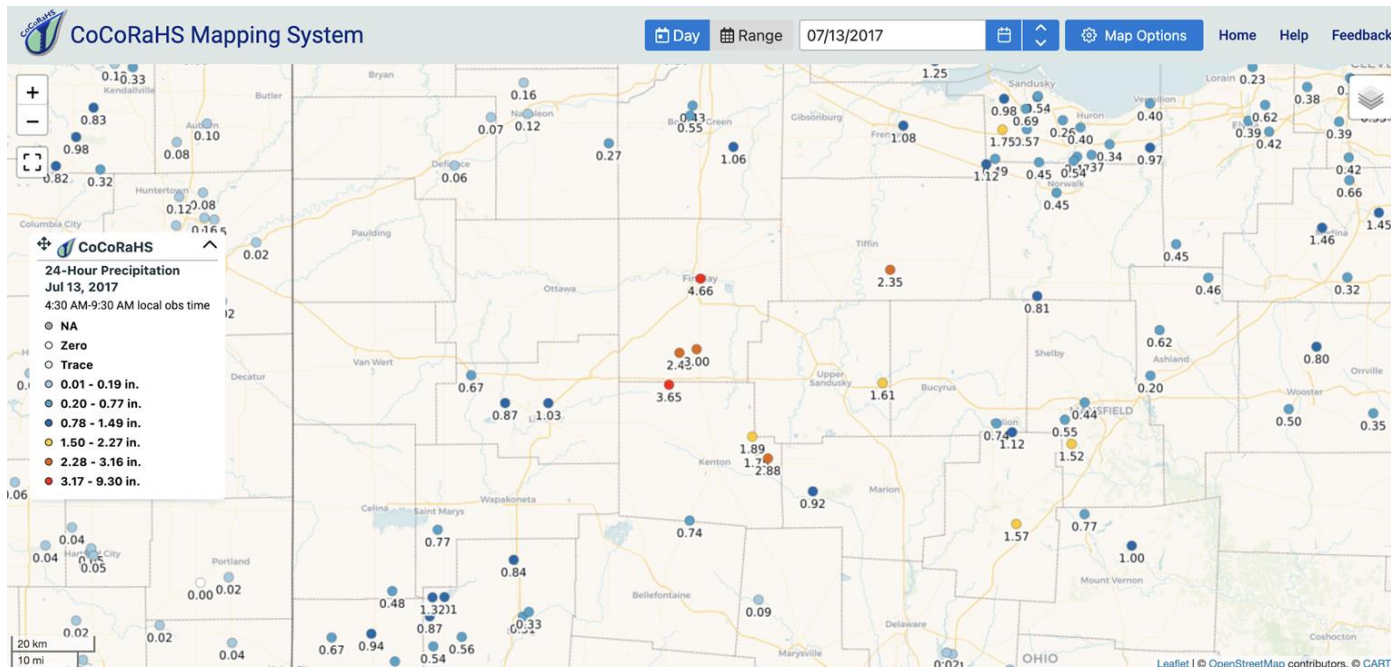


Number of 1" or greater events per 5-yr increments from 1950-2019



1" or greater events expressed as a percentage of the total number of rain events by year between 1948 and 2020

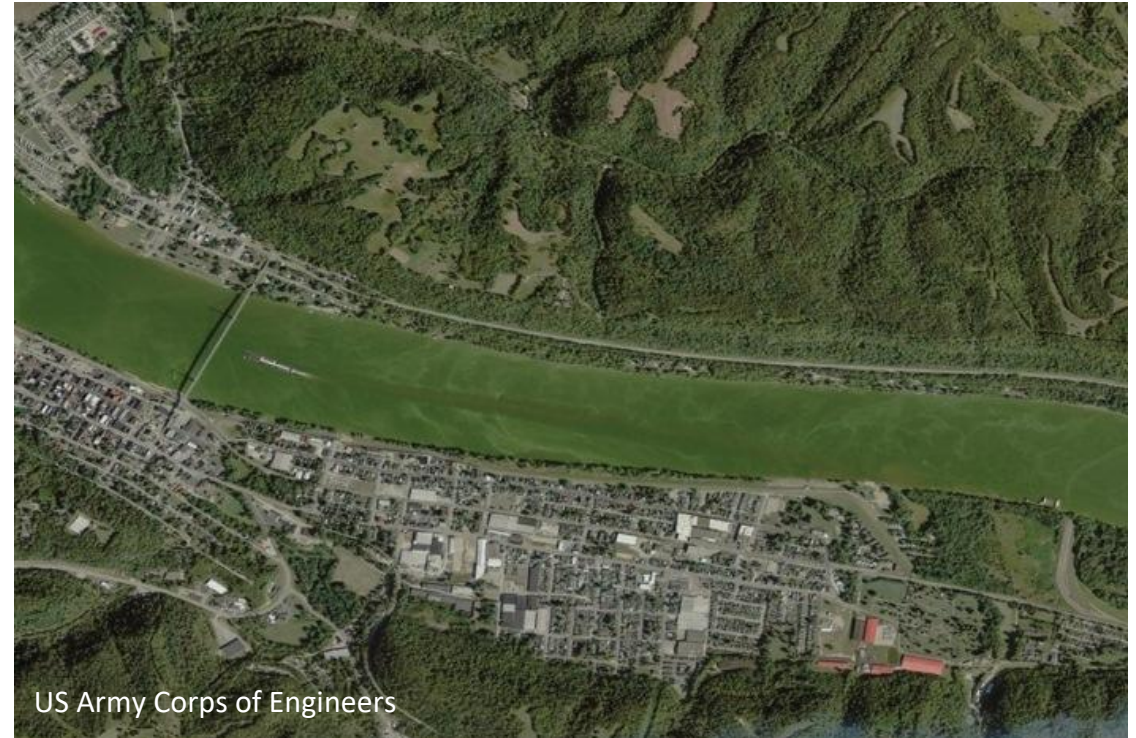
Rural Flooding



Rural Flooding

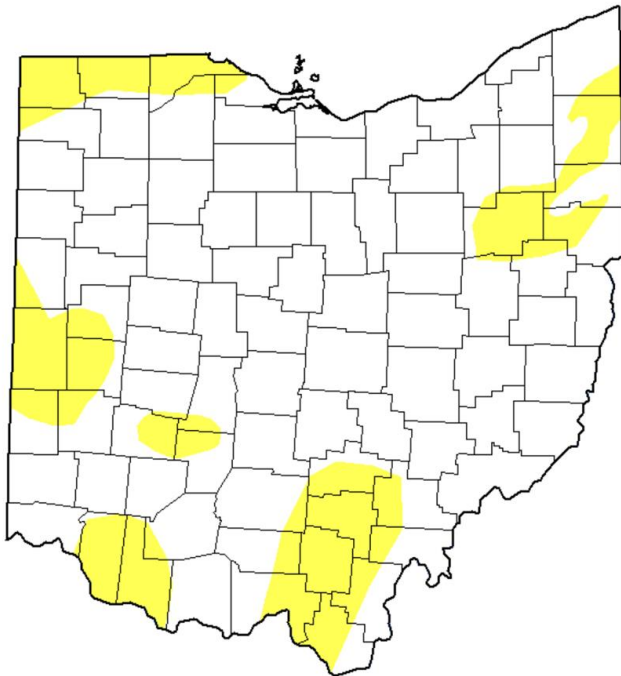


Rivers & Lakes



Drought – In a Flash

U.S. Drought Monitor Ohio



October 4, 2022
(Released Thursday, Oct. 6, 2022)
Valid 8 a.m. EDT

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	80.32	19.68	0.00	0.00	0.00	0.00
Last Week 09-27-2022	93.91	6.09	0.00	0.00	0.00	0.00
3 Months Ago 07-05-2022	64.06	35.94	0.00	0.00	0.00	0.00
Start of Calendar Year 01-04-2022	100.00	0.00	0.00	0.00	0.00	0.00
Start of Water Year 09-27-2022	93.91	6.09	0.00	0.00	0.00	0.00
One Year Ago 10-05-2021	96.49	3.51	0.00	0.00	0.00	0.00

Intensity:

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. For more information on the
Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

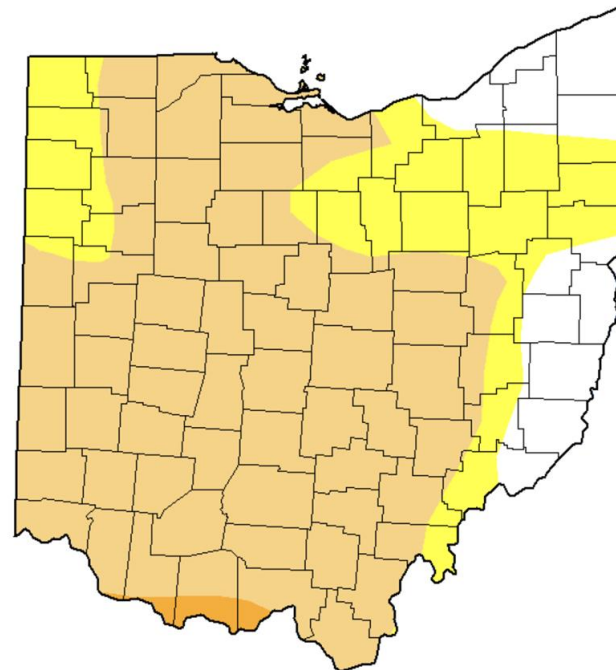
Author:

Brad Pugh
CPC/NOAA



droughtmonitor.unl.edu

U.S. Drought Monitor Ohio



November 8, 2022
(Released Thursday, Nov. 10, 2022)
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	11.70	88.30	66.76	1.04	0.00	0.00
Last Week 11-01-2022	14.44	85.56	42.64	0.00	0.00	0.00
3 Months Ago 08-09-2022	95.11	4.89	0.00	0.00	0.00	0.00
Start of Calendar Year 01-04-2022	100.00	0.00	0.00	0.00	0.00	0.00
Start of Water Year 09-27-2022	93.91	6.09	0.00	0.00	0.00	0.00
One Year Ago 11-09-2021	99.95	0.05	0.00	0.00	0.00	0.00

Intensity:

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. For more information on the
Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

Author:

Brian Fuchs
National Drought Mitigation Center



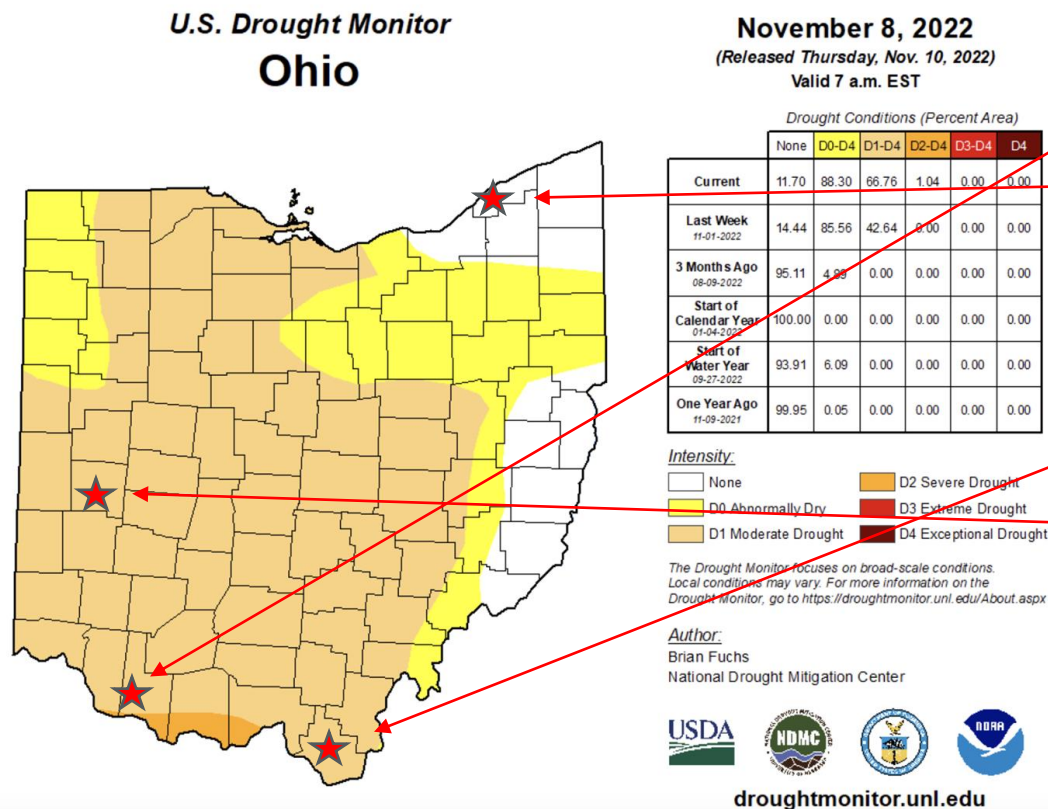
droughtmonitor.unl.edu



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Drought & Fire

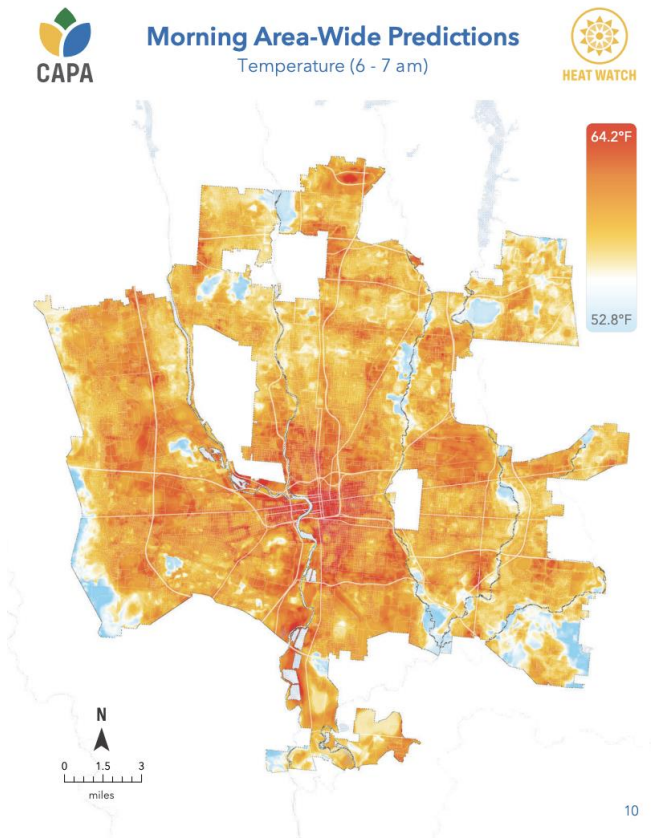
- With fall agriculture nearly completed, “typical” ag impacts were muted, but...



- 4 brush fires reported in Clermont County as drought drags on
- Brush fires break out again in Lake County for at least 2nd day in row
- Wildfire burns part of southern Ohio's Wayne National Forest -> *1,300 acres*
- Campfire, dry conditions lead to fast moving fire at Lost Creek Prairie Preserve in Tipp City



Heat and Air Quality

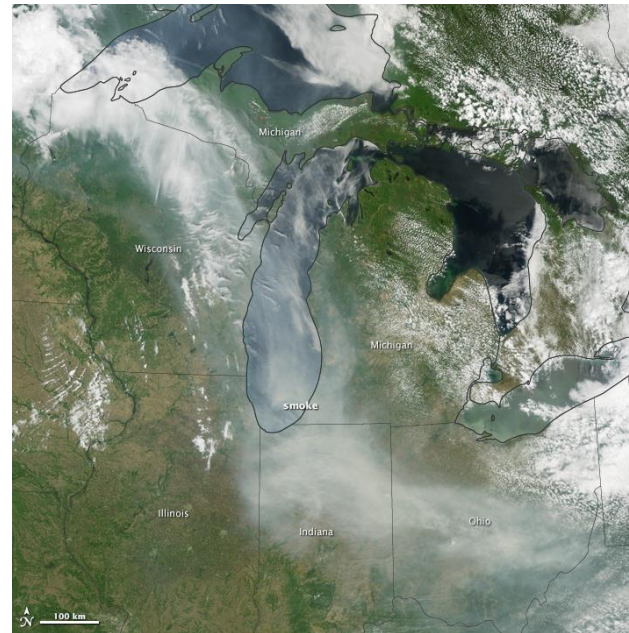


Western Wildfire Smoke in the Midwest

FOX26NEWS

+ Follow

Smoke in the Valley increases doctor visits & 911 calls



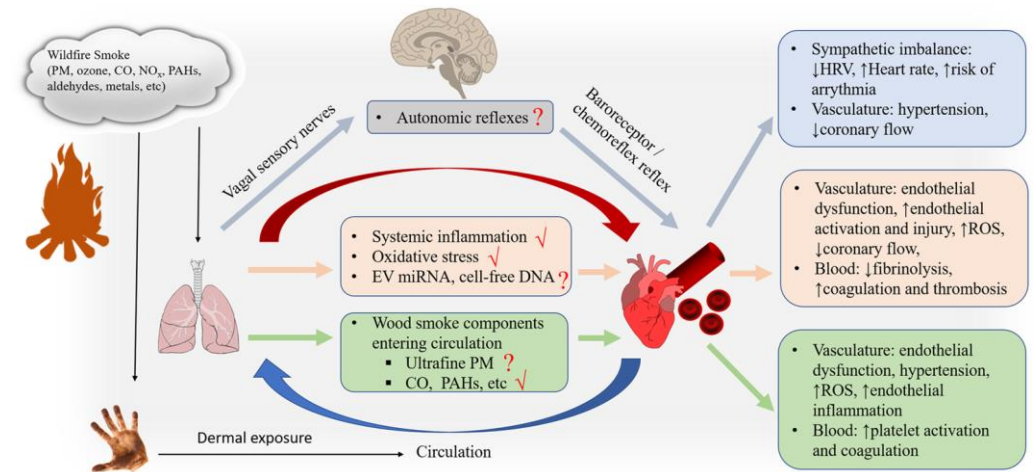
Review | Open Access | Published: 07 January 2021

Cardiovascular health impacts of wildfire smoke exposure

Liao Chen, James M. Samet, Philip A. Bromberg & Haiyan Tong

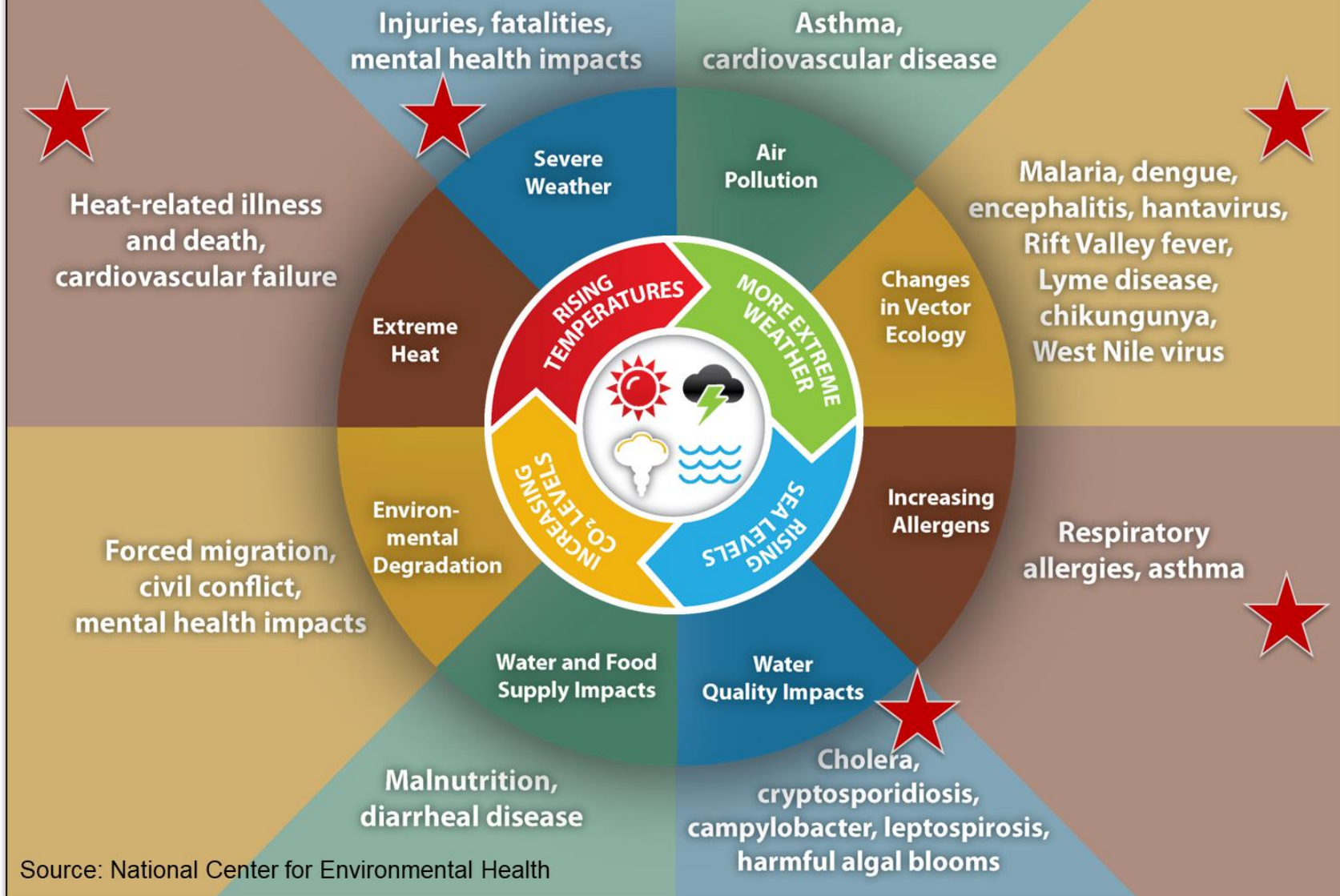
Particle and Fibre Toxicology, 18, Article number: 2 (2021) | Cite this article

9216 Accesses | 27 Citations | 243 Altmetric | Metrics



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Impact of Climate Change on Human Health



Climate Change is a Risk Multiplier

Flood hits Eastern Kentucky health clinics as patients seek medication, care for injuries



Deborah Yetter
Louisville Courier Journal

Published 5:30 a.m. ET Aug. 1, 2022 | Updated 6:48 a.m. ET Aug. 1, 2022

[View Comments](#)



Chovies, Kentucky

VIDEO: See what the flooding has done in Chovies, Kentucky after historic rains
Historic rains turned a small creek into a lake and washed homes from their foundations Michael Clevenger and Scott Utterback, Louisville Courier Journal

When the flood waters receded, staff of the [Whitesburg Medical Clinic](#) on Friday found furniture overturned, medical equipment ruined, files and computers waterlogged, and more than a foot of mud and water inside.

But no employees lost their lives — though some [lost relatives](#), homes, and vehicles — and many went to work shoveling mud and cleaning floors and furniture in order to salvage at least a small portion of the clinic in the small mountain town, the seat of Letcher County.

Original Articles

The impact of climate change and natural disasters on vulnerable populations: A systematic review of literature

Mia A. Benevolenza & LeaAnne DeRigne

Pages 266-281 | Published online: 10 Oct 2018

[Download citation](#)

<https://doi.org/10.1080/10911359.2018.1527739>

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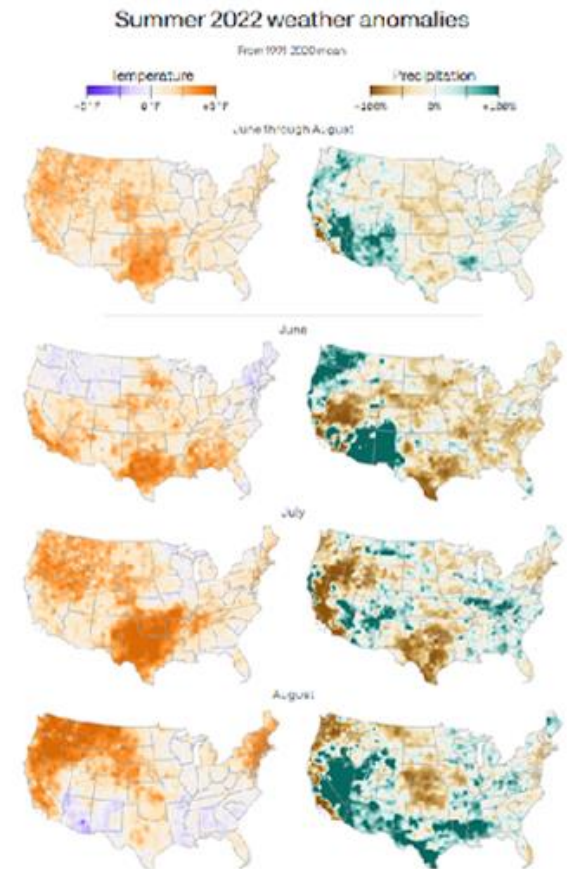
[Get access](#)

ABSTRACT

Climate change is acknowledged as being a crucial determinant of public health. The United States is experiencing an increase in the frequency and intensity of natural disasters as a result of climate change activity, influencing the ways federal, state, and local governments are addressing the growing issue. Individuals who are vulnerable to the effects of extreme weather, namely the poor, the elderly/disabled, children, prisoners, and substance abusers have experienced heightened levels of mental, emotional, and bodily stress due to natural disaster exposure. Researchers from a variety of disciplines, public health, social science, and environmental studies, in particular, are examining how natural disasters are impacting mental and physical health functioning while noting the demographic factors leaving

Rel:

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[Cha](#)
[Disa](#)
[Gra](#)
[Envir](#)
[Publ](#)
[Clim](#)
[disa](#)
[prac](#)

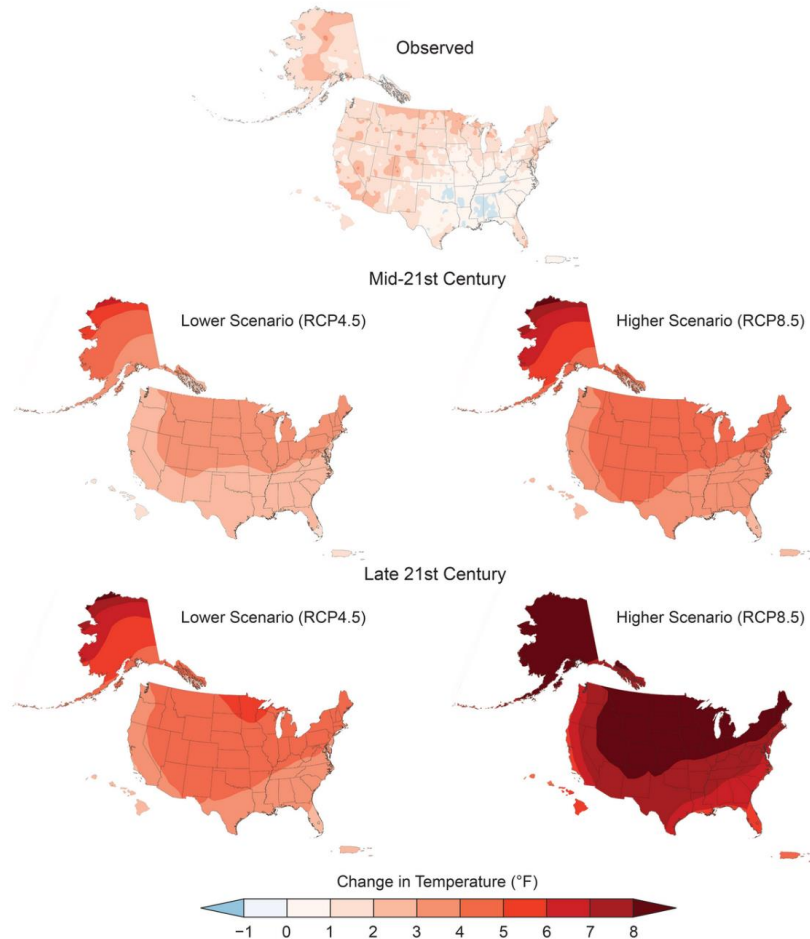


Data: NOAA, Climate.gov, Climate.gov Visuals



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Our Future Climate: Temperature

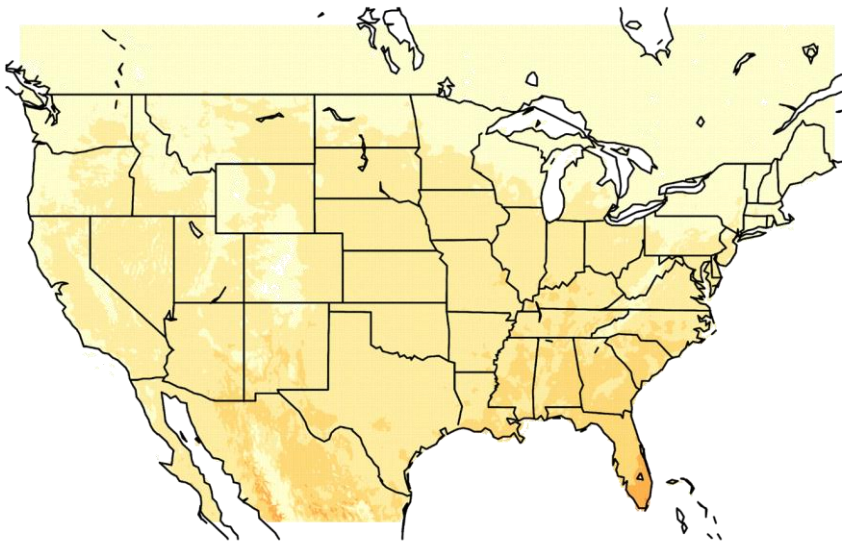


- Likely reflected by winter warming and warmer nighttime temperatures
- Mid-Century Change: 3-5°F warmer
- Late-Century Change: 4-8°F warmer

Change in Number of Days > 90°F

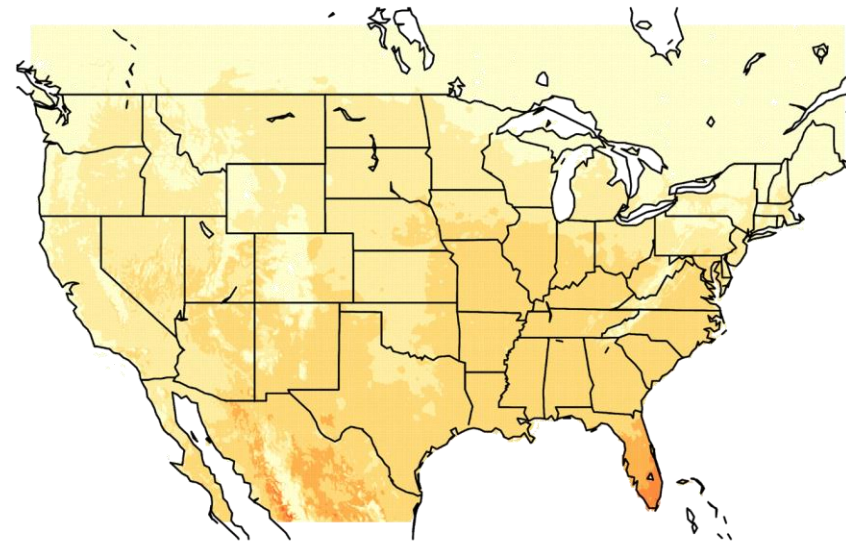
Intermediate Scenario

Change in annual #days Tmax > 90F by mid 21st century



Very High Scenario

Change in annual #days Tmax > 90F by mid 21st century



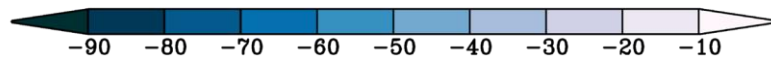
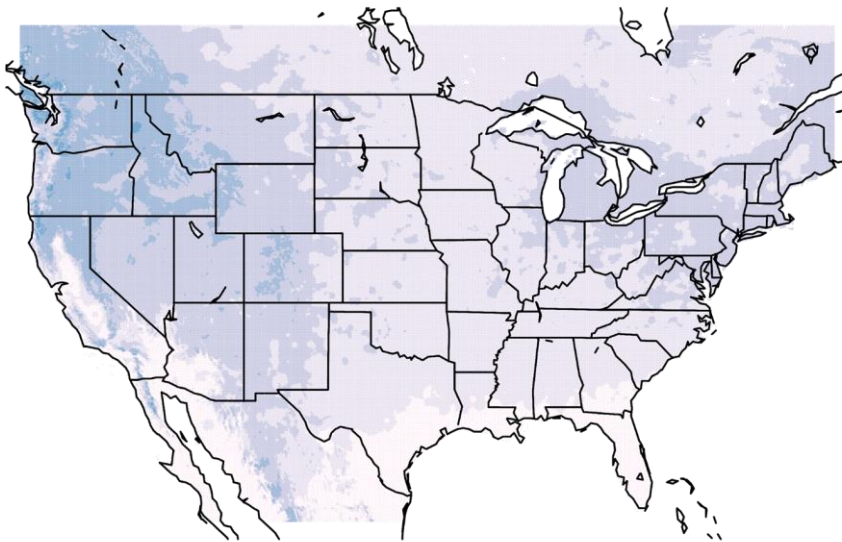
<https://scenarios.globalchange.gov/loca-viewer/>

- **Contemporary Period (1976-2005): 20-40 days per year**

Change in Number of Nights $< 32^{\circ}\text{F}$

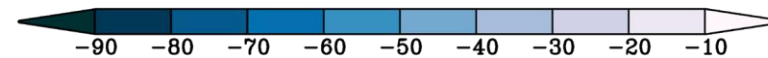
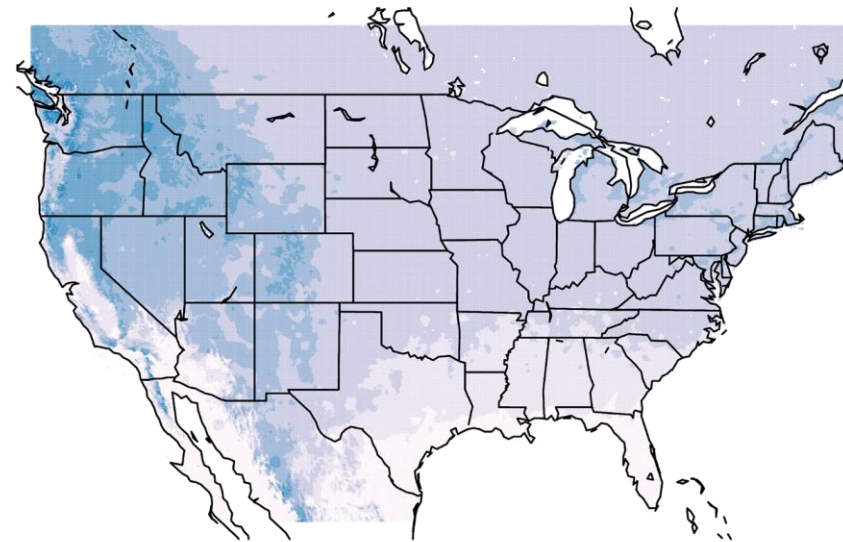
Intermediate Scenario

Change in annual # of frost days by mid 21st century



Very High Scenario

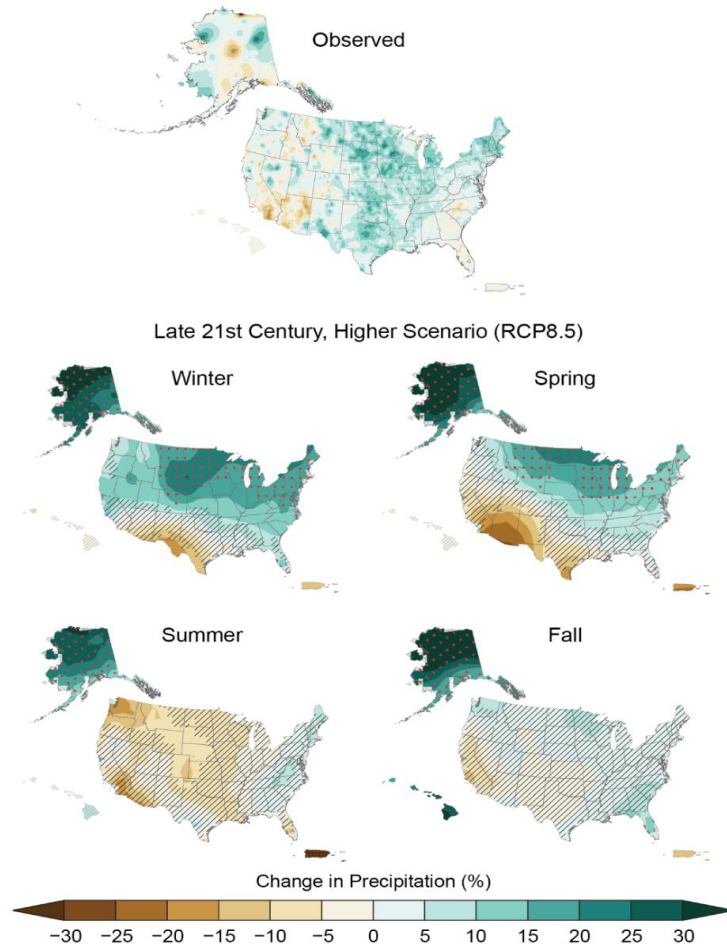
Change in annual # of frost days by mid 21st century



<https://scenarios.globalchange.gov/loca-viewer/>

- **Contemporary Period (1976-2005): 80-160 days per year**

Our Future Climate: Precipitation

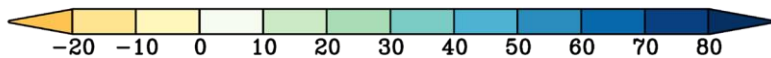
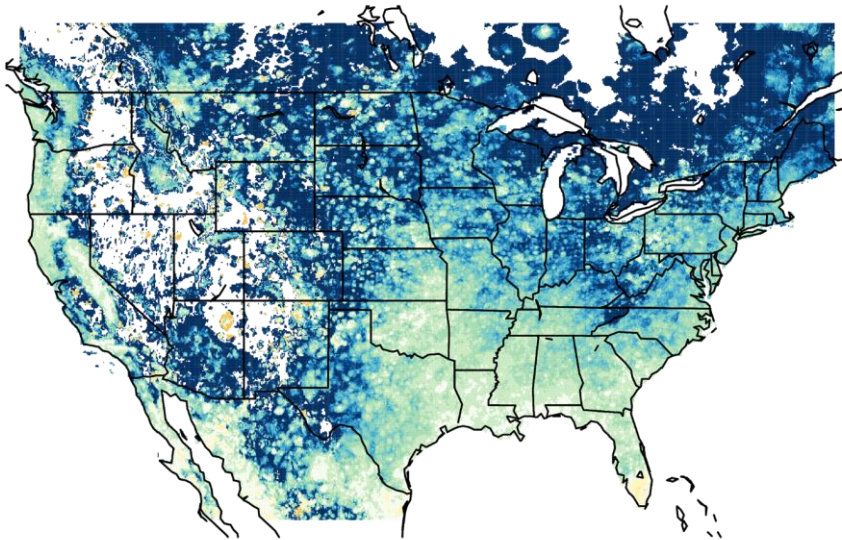


- Driven by increased water vapor (humidity)
- Seasonal changes atmospheric circulation
- Wetter cool season; drier summer season = could mean intensified drought

Change in Mean Annual Days w/Precipitation > 2"

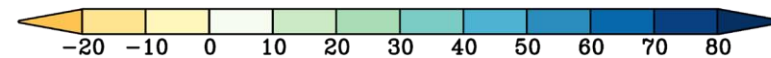
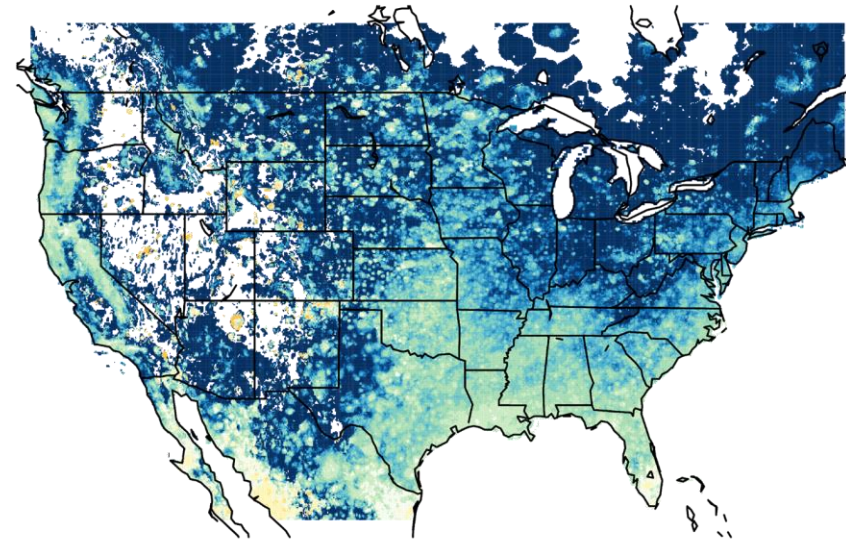
Intermediate Scenario

Change (%) in annual #days > 2 inches by mid 21st century



Very High Scenario

Change (%) in annual #days > 2 inches by mid 21st century



<https://scenarios.globalchange.gov/loc-viewer/>

- **Contemporary Period (1976-2005): < 1 per day**

Assessing Vulnerabilities and Risk

Primary Projected Climate Changes and Impacts for Columbus

- Rising Temperatures
 - Longer Growing Season
 - Deteriorated Air Quality
 - Extreme Heat
 - Shifting Natural Resources
- Increasing Precipitation
 - Deteriorated Water Quality
 - Increased Flood Risk
 - Changing Seasonal Precipitation
 - Changes to Water Availability

Social and Demographic Changes for Central Ohio

In their recent “Insight2050” report, the Mid-Ohio Regional Planning Commission (MORPC) found that Central Ohio’s population is expected to grow by more than 500,000 additional people in the next 35 years, with more of the population being significantly younger (less than 35 years old) or significantly older (more than 65 years old). These trends, indicating that more of the population will be at a vulnerable age, highlight the need for planning that considers not only a changing climate but changing demographics.

(Source: Insight2050)

Relationship between climate changes, impacts, and vulnerabilities

Climate Changes (2)

Climate Impacts (8)

Climate Vulnerabilities (14)

<https://byrd.osu.edu/columbus>



Increasing Precipitation

Greater Flood Risk

Ohio has seen large increases in heavy storms that can lead to flooding. Models project those trends will continue, increasing flood damage risks to infrastructure and public health.

Increased risk of damage to energy and water infrastructure due to increased frequency of flood events and changing floodplain.
(roads, floodwalls, dams, electric grid, water intakes, etc.)

*Public Works/Capital Projects
Transportation/Bridges
Energy Provider/Utility
Water Providers/Utilities*

Increased incidence of health risks associated with a flood.
(mold, exposure to chemicals and waterborne pathogens, vector control, drinking water and food contamination)

*Public Health/Local Hospitals and
Medical Providers
Division of Environmental Health*

Increased transportation issues during/following a flood. (causing major disruptions to local economy, difficult for police and ambulances to respond to emergencies when areas are flooded)

*Emergency Services
Transportation
Public Works*

Changing Seasonal Precipitation

As temperatures warm and precipitation increases, the form and timing of precipitation will likely change. The number of days dry enough to plant crops in the spring may be reduced, and the potential for rain on semi-frozen ground may increase.

Increased infrastructure and property damage due to extreme weather.
(ice, floods, strong winds, heavy/wet snow impacting power lines, roads, roofs, etc.)

*Public Works/Capital Projects
Transportation
Energy Providers/Utilities
Water Providers/Utilities
Insurance Companies
Homeowner Groups/Associations*

Reduced Water Quality

With stronger storms come flashier flows, more runoff, and greater chances of sewer overflows that can contaminate water supplies.

Increased need for water treatment due to deteriorated water quality.
(more air pollution settling in water, more runoff containing pollutants during major precipitation events, higher turbidity, more fertilizers and pesticides used for longer growing season, harmful algal blooms, etc.)

*Water Providers/Utilities
Division of Environmental Health
Agriculture*

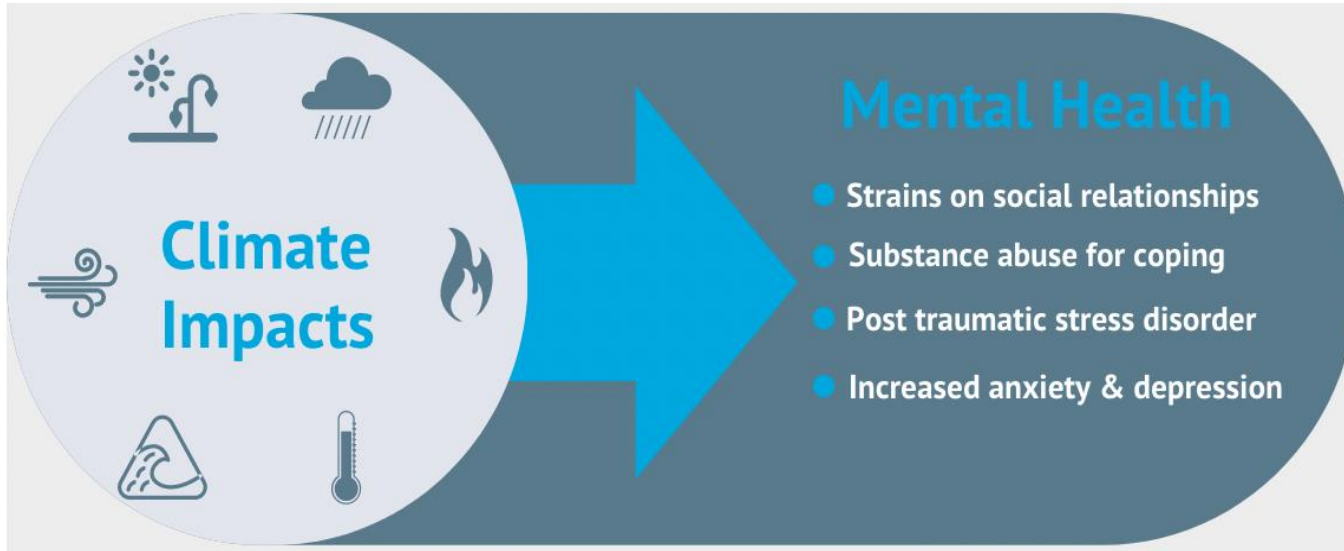
Summer Water Availability

Many models project summer precipitation will decline even as precipitation increases during other seasons. This raises the potential for summer droughts and seasonal water shortages, particularly for agricultural and industrial use.

No priority vulnerabilities related to this climate impact were identified during the vulnerability assessment



Climate Change and Mental Health



Source: nihcm.org/publications/climate-change-is-affecting-our-mental-health

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Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey

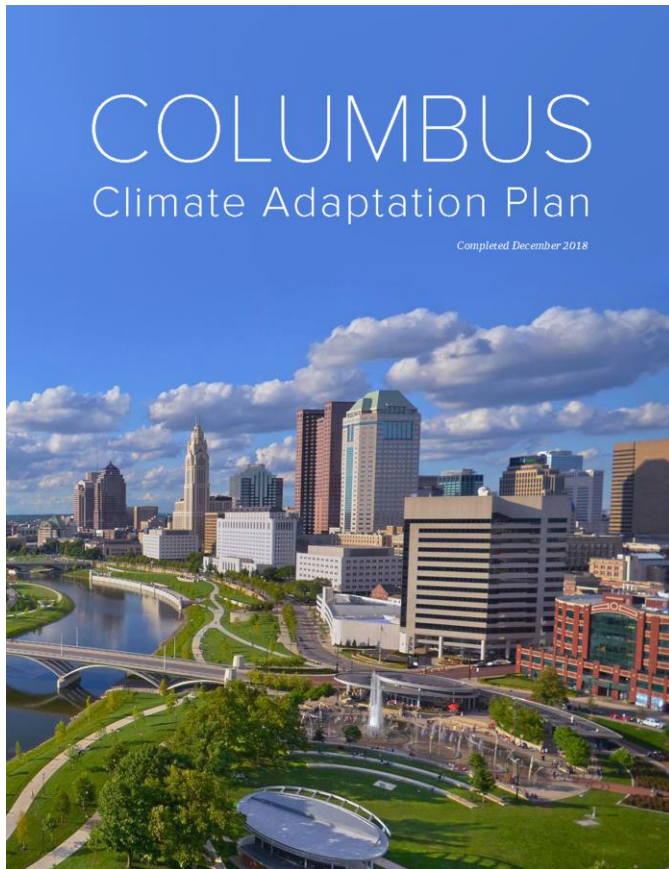
Caroline Hickman, MSc [✉](#) [†](#) • Elizabeth Marks, ClinPsyD [†](#) • Panu Pihkala, PhD • Prof Susan Clayton, PhD • R Eric Lewandowski, PhD • Elouise E Mayall, BSc • et al. [Show all authors](#) [Show footnotes](#)

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Resilience



The Climate Action Plan (CAP) was developed by many stakeholders with commitments to reduce the negative impacts of climate change through the CAP Focus Areas. The following sections are meant to provide a snapshot of the many ways each Focus Area contributes to climate action as they contain relevant key facts, main goals, cross-cutting priorities this area can advance, and an overview of the corresponding objectives and actions that make up the plan. For a more detailed description of plans for action implementation, refer to Appendix E, "Climate Action Implementation Plans."



Energy Efficiency & Green Building



Clean Energy



Sustainable Transportation



Clean Water & Vibrant Green Space



More Local Food, Less Waste



Cross-Cutting Priorities

Reports by City and Regional Organizations

Central

City of Columbus - *Climate Change in Columbus, Ohio*

City of Columbus - *Climate Change Adaptation Plan*

Northeast

City of Cleveland - *Cleveland Climate Action Plan*

City of Akron - *Greenprint*

Northwest

City of Toledo - *City Fact Sheet: Toledo, Ohio*

Southeast

City of Athens - *Athens Sustainability Action Plan*

Southwest

City of Cincinnati - *Green Cincinnati Plan*

City of Dayton - *The Potential Impacts of Climate Change on Dayton, Ohio*

<https://byrd.osu.edu/columbus>

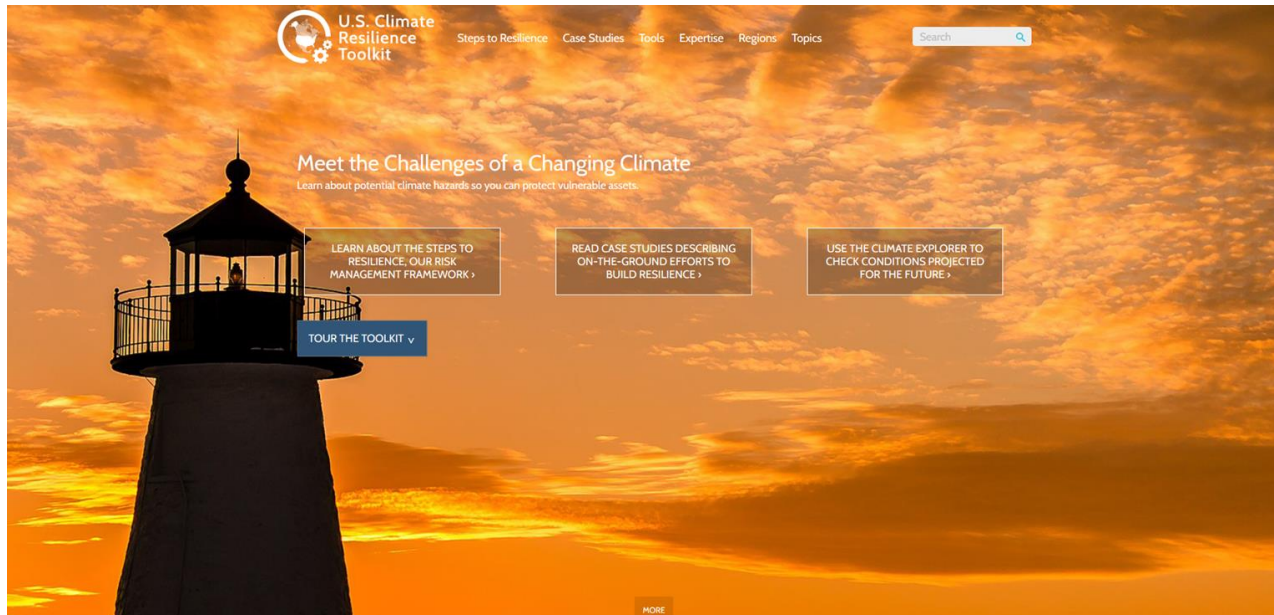


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https://www.sustainablecleveland.org/climate_action

<https://climate.osu.edu/ohio-climate-change-resources>

Resilience



Thank You

Questions? Email:

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State Climatologist: Aaron Wilson (wilson.1010@osu.edu)

